CIVIL ENGINEERING

AUGUST 1950

THE MAGAZINE OF ENGINEERED CONSTRUCTION

Canada's First Subway—
Paterson, Molineaux

More Effective Use of
Water Resources—Horner

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

WINTER CONCRETING proceeds at 50,000 cu yd Des Joachims Development in Ontario by use of heated water and sand for concrete and steam heated housing over forms. See article by G. Mitchell and R. B. Young.

Raymond

MAKES 5 TYPES OF CONCRETE PILES

1. STANDARD . . . 2. STEP-TAPER . . . 3. PIPE STEP-TAPER

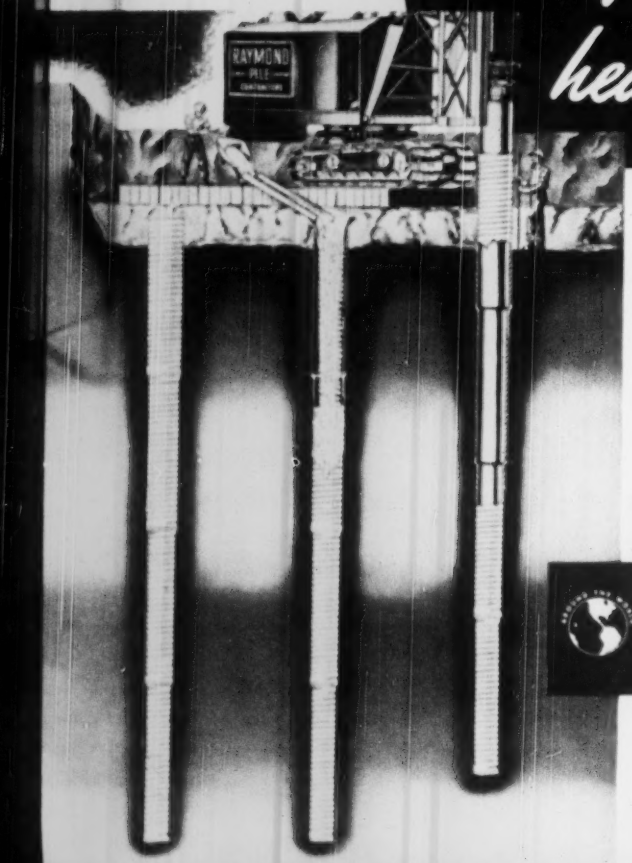
4. COMPOSITE . . . 5. GOW CAISSONS

Raymond installs every type of pile: cast-in-place concrete, precast concrete, steel pipe, wood and H-beam. Raymond operations include underpinning, borings and soil investigations, waterfront construction and harbor and river improvements, also cement mortar lining of pipes by the Centriline Corporation, a Raymond Subsidiary

At left, completed Step-Taper Pile. Center, filling the permanent steel shell with concrete after internal inspection. Right, driving the pile with rigid core.

2. STEP-TAPER PILES

FOR *long lengths* WITH *heavy loads*



Raymond Step-Taper Concrete Piles driven with rigid steel cores and heavy hammers are designed to develop high load-carrying capacities at depths to 80 feet. The permanent steel shell maintains the resistance developed during driving. After the shell is inspected internally, it is filled with concrete and cut off at the specified elevation.

You are invited to discuss with our engineers the efficiencies and savings made possible by Raymond's exclusive, original concrete pile designs.

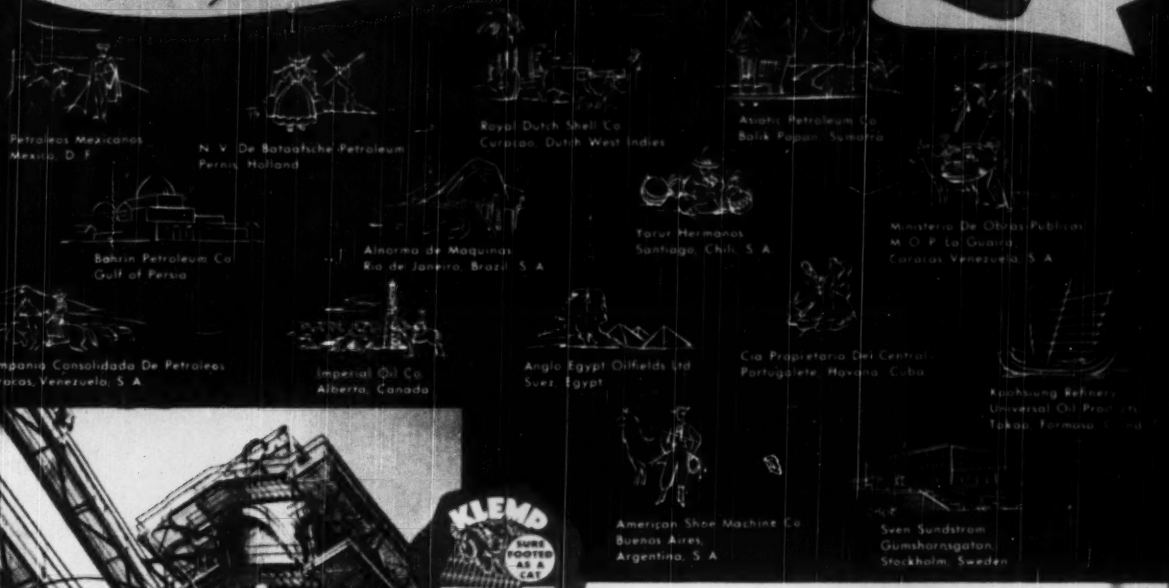
◀ RAYMOND PILES MAINTAIN DRIVING RESISTANCE

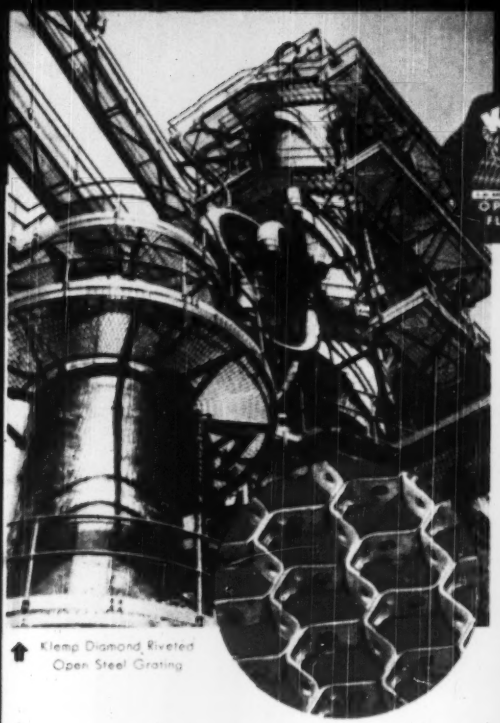
Raymond CONCRETE PILE CO.

140 CEDAR ST., NEW YORK 6, N. Y.

BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America

Far Away Places--and Strange Sounding Names....





Klemp Diamond Riveted Open Steel Grating

Klemp HEXTEEL Canister Lining Reinforcement Meshes for Cat Crackers and Pipe Lines.

KLEMP SURE FOOTED AS A CAT OPEN STEEL FLOORING

KLEMP

World's Largest Manufacturer of Open Steel Meshes

The WM. F. KLEMP COMPANY for more than 43 years has shipped its open steel and aluminum grating and treads, ganister lining reinforcement meshes, and open steel and aluminum bridge deckings to the leaders of industry, construction and commerce in the four corners of the world.

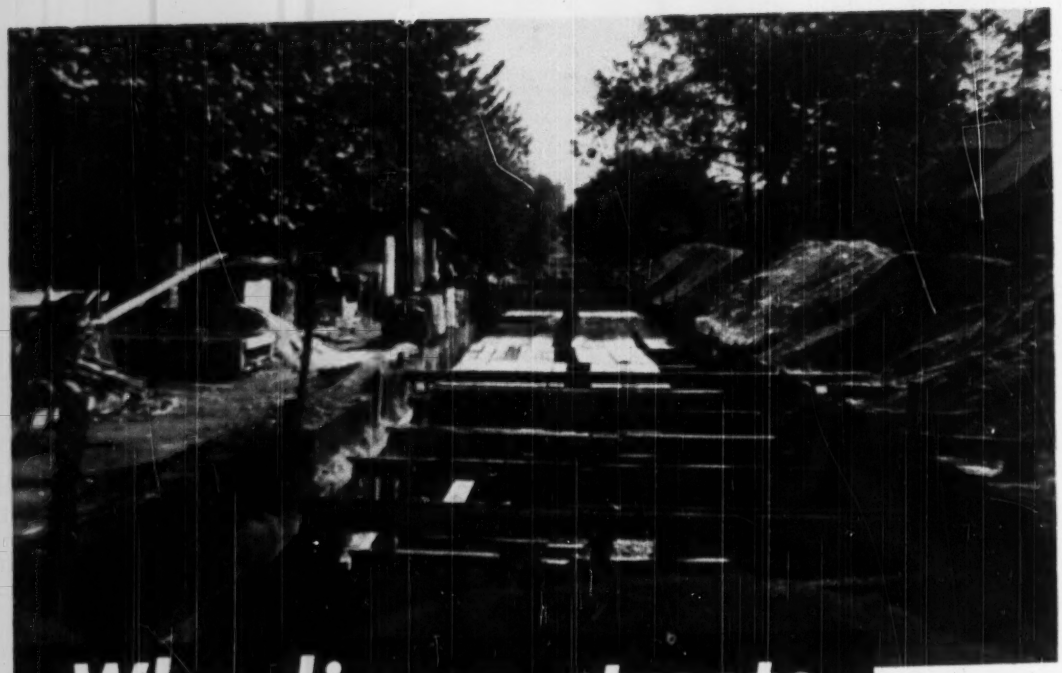
● *Send for our new catalogs!* See how we meet the needs of modern industry by fabricating the following superior products to our customers' exacting specifications:

KLEMP HEXTEEL HEAVY DUTY SURFACE ARMOR
KLEMP DIAMOND RIVETED OPEN STEEL GRATING
KLEMP SERRATED GRATING & TREADS
KLEMP SPANSTEEL EXPANDED METAL
KLEMP FLOORSTEEL FLEXIBLE FLOOR ARMOR
KLEMP ELECTRO-FORGED GRATING & TREADS
KLEMP FLEXSTEEL CONVEYOR BELTS
KLEMP STEEL SAFETY MATS

Our specialized experience in solving difficult flooring and pipe and vessel lining problems is at your service. Write for our new catalogs *today!*

WM. F. KLEMP COMPANY

6611 South Melvina Avenue, Chicago 38, Illinois



Why dig up streets

for underground structures?

You need not destroy expensive pavements and disrupt business to put in sewers and other underground structures. The simple, low-cost way is to tunnel the job with the aid of Armco Liner Plates. The work moves quickly. Business above ground goes on as usual.

Although amply strong, these lightweight corrugated metal plates are easy to handle. One man can carry, hold and bolt a section into place. No special equipment is needed.

But that's not all. With Armco Tunnel Liner Plates there is less excavation—less dirt to be handled and hauled away. And bad weather is never a problem.

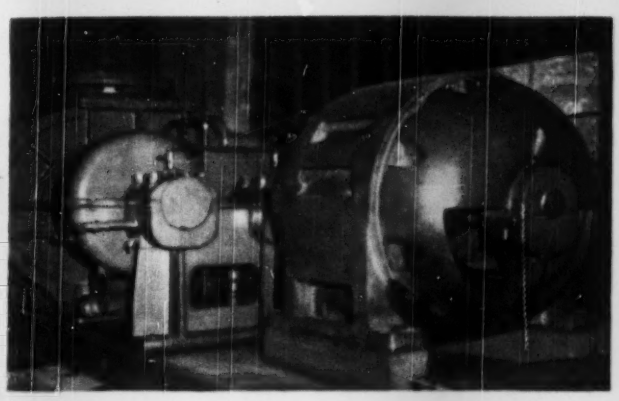
Try tunneling that next job with Armco Liner Plates and see for yourself how they save you time, trouble and money. Diameters of Armco Tunnels range from 45¼ inches to 33 feet. Write for prices and other information. Armco Drainage & Metal Products, Inc., 5590 Curtis St., Middletown, Ohio. Subsidiary of Armco Steel Corporation.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

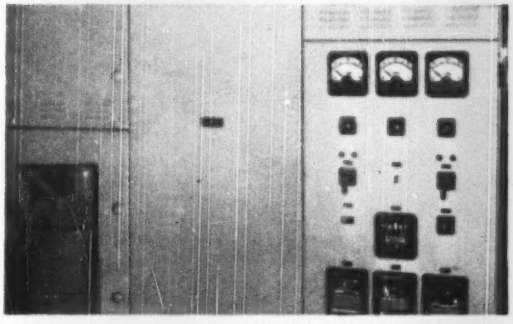
ARMCO

ARMCO TUNNEL LINER PLATES

Ventilation for the Delaware Aqueduct tunnel is provided by blowers driven by sturdy G-E 200-hp induction motors. ▶



▲ Muck is efficiently hauled by 18 G-E battery and battery-trolley locomotives.



▲ Adequate d-c power for trolley service is obtained from eight G-E 150-KW stationary mine-type mercury-arc rectifiers specially designed for this project.

tunneling through the CATSKILLS ... *Electrically*

to bring more water to New York City

Adding 300 million gallons a day to New York City's water supply is a big job no matter how it's done. To help bring it from the Delaware River, the Walsh Construction Co. and B. Perini and Sons must bore 25 miles through the Catskill Mountains. At about 70 feet a day, they've still a long way to go, but expect to complete the job around July 1955 with *electrified* equipment co-ordinated and engineered by General Electric.

Every day, more contractors are looking to reliable *electrified* equipment for flexibility, safety, and ease of maintenance. With equipment driven by G-E motors and control, and supplied from G-E power distribution systems they get modern *electric drives* with the added advantages of G-E engineering assistance in application, installation and service. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

Ask him Today!

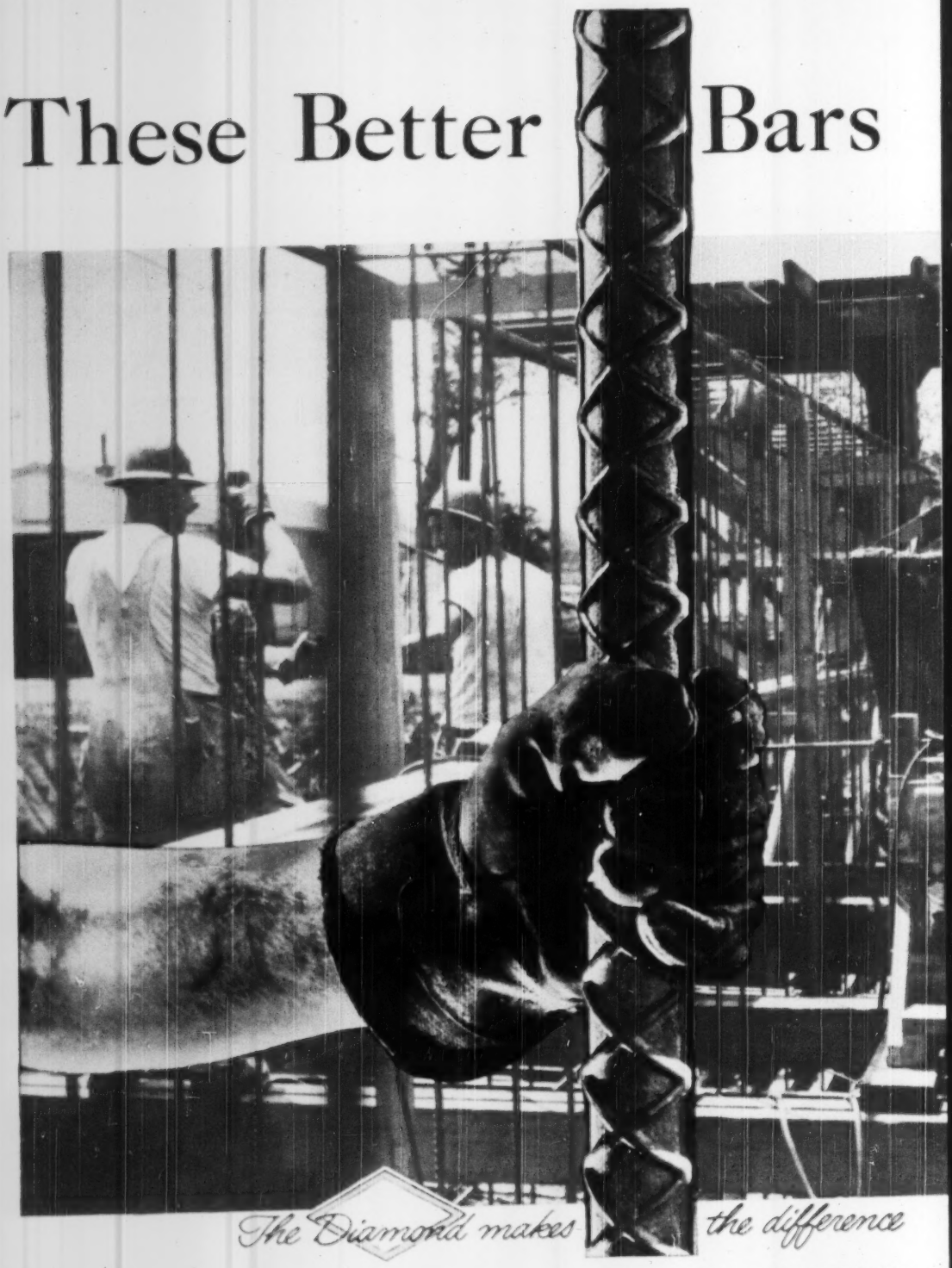
Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.

Electrified Construction
BETTER PRODUCT
LOWER COST

GENERAL ELECTRIC

CIVIL ENGINEERING, August, 1950. Vol. 20, No. 8. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

These Better Bars



The Diamond makes the difference

mean Better Jobs

U·S·S DI◇LOK

CONCRETE REINFORCING BARS

Closely spaced ribs—forming deep, diamond-shaped recesses—give you stronger concrete construction

YOU can count on extra anchorage between concrete and steel when you design your jobs with U·S·S Di-Lok, the improved concrete reinforcing bar that meets every requirement of ASTM Specification A305-49.

The U·S·S Di-Lok features that account for its exceptionally high bond strength are quickly evident in the life-size photo. Note the extremely close spacing of diamonds on the bar. Note, too, the pronounced height of the ribs. These two features provide more grip, and a tighter grip per foot. This minimizes the tendency to slip under high loads and checks the formation of tensile cracks.

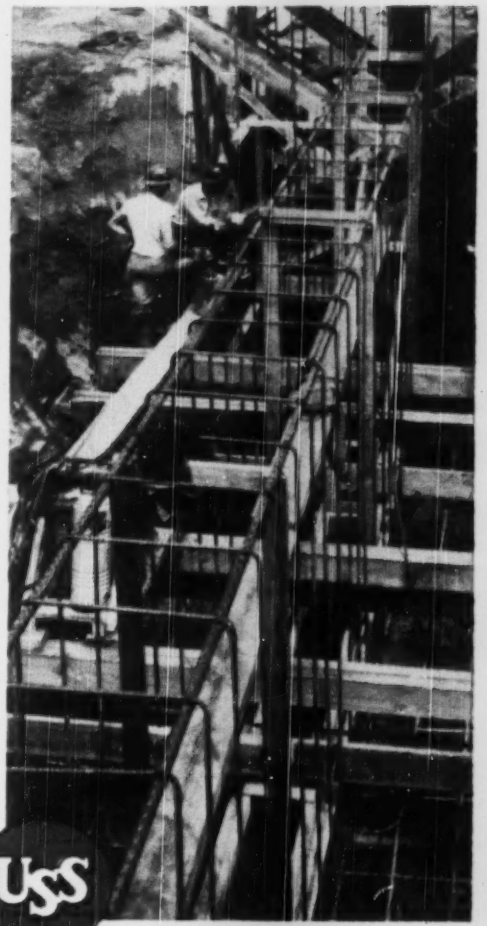
By taking advantage of the extra bond strength provided by U·S·S Di-Lok, you can minimize bending and other fabricating operations. And, in some cases, steel and concrete requirements can be reduced.

In addition to providing greater bond strength, the closely-spaced, diamond-pattern ribs also make for easier handling. U·S·S Di-Lok bars lie freely atop and beside one another. Do not interlock when bundled or stacked in racks. Thus, individual bars can be withdrawn freely.

U·S·S Di-Lok can be readily fabricated to meet close tolerances for all types of bends.

Made only from new-billet steel, U·S·S Di-Lok concrete reinforcing bars are available in standard sizes. Produced in six strategically located plants around the country: Pittsburgh, Pa.; Youngstown, Ohio; Gary, Ind.; Birmingham, Ala.; Pittsburg, Cal. and Torrance, Cal. Stocks are carried by leading fabricators in most principal cities.

To make your *next* job a *better* job, specify U·S·S Di-Lok. It is *the* reinforcing bar for building stronger, more durable concrete structures—and doing the job economically. Call us for the name of your nearest distributor.



USS

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM

UNITED STATES STEEL

Construction view, State Office Building, Jackson, Miss. Architects: E. L. Malvaney & Assoc. Structural engineer: Harry Howe. Contractor: J. A. Jones Construction Company.

Quality Construction at substantial savings with CONCRETE FRAMES AND FLOORS

REINFORCED concrete frame and floor construction offers both high quality and economy. A typical example is the State Office Building in Jackson, Miss. illustrated above, where it was considered the most economical high-grade construction for a building of this type and size.

Cost analyses and competitive bids throughout the nation show that savings up to 40% are made with reinforced concrete frames and floors.

Substantial savings in time result too. Frame and floor construction proceed simultaneously. Thus masons, plumbers, electricians and other tradesmen can do their jobs while the structural work progresses. Such construction meets all the requirements for flexibility in conduit layout.

Slab band floor construction, which was used in the State Office Building in Jackson, also permits a reduction in total building height. This saving is due to the elimination of the headroom required by conventional beams and girders in other types of construction.

Architects and structural engineers like the wide latitude and flexibility they have in locating partitions with slab band floors. The result is efficient use of total floor area.

Should you desire help in attaining quality concrete or the maximum structural advantages of reinforced concrete construction on any project our technical staff will be glad to assist you.

If you want more information about reinforced concrete frame and floor construction write for two free booklets: *"Continuity in Concrete Building Frames,"* and *"Handbook of Frame Constants,"* distributed only in the U. S. and Canada.

PORTLAND CEMENT ASSOCIATION

DEPT. 8-13, 33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

Engineers Confirm in the Field the Strength and Accuracy Technical Editors Found in Gurley Aluminum Alloy Transits

Gurley Instruments

An article describing the advantages of aluminum construction of Gurley instruments where accuracy, strength, lightness and freedom from vibration are essential

Aluminum Used Successfully in Precision Instruments

A PICTORIAL STORY

Requirements of accuracy during a long service life are controlling factors in selection of materials for engineering and surveying instruments.

Combining durability and lightness with precision for surveying transits

FROM AN EXPLORER:

"Have been using your instruments since 1906, which I purchased for surveys in Mexico—and they are as good as ever."

FROM AN ENGINEER SOMEWHERE IN EUROPE:

"Your instruments can take it. I have been using a Gurley Transit here in Europe for the past year under the roughest kind of treatment and it is still in perfect adjustment."

FROM A COMBAT ENGINEER IN WORLD WAR II:

"I spent three years overseas as chief of a survey party. We were required to do very accurate work. We used Gurley 20-second transits and after being dropped and about everything else, they still did work up to par."

From the first model

—built in 1876 and retired after 50 years of service—Gurley Aluminum Alloy Transits have met every field requirement for strength, lightness, freedom from vibration and permanent accuracy—in heat, cold and the roughest treatment. For complete details about Gurley instruments, write for your free copy of Catalog 50.

GURLEY

Surveying and Scientific Instrument Makers
Since 1845

W. & L. E. GURLEY, 518 FULTON STREET, TROY, N.Y.

Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments and Meteorological Instruments.

CHAMPION

WORKIN'EST

Here are some of the exclusive features that give the TD-24 its matchless work capacity:

1. 180-h.p. International diesel engine with gasoline-conversion starting and unmatched "lugability".

2. Synchromesh transmission for easy shift-on-the-go operation, plus eight speeds forward and eight reverse.

3. Planet Power drive, smooth and rugged, for instant speed change up or down one gear without declutching.

4. Planet Power steering to provide power on both tracks in gradual turns and permit feathered or pivot turns.

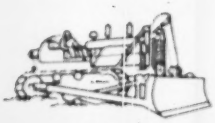
5. Separate reverse lever for quick change of direction of travel in any of the eight transmission speeds.

6. High-speed track assemblies with new recoil mechanism that holds front idlers in position against full-load track pull.

The NEW TD-24

CRAWLER TRACTORS • WHEEL TRACTORS

DIESEL ENGINES • POWER UNITS



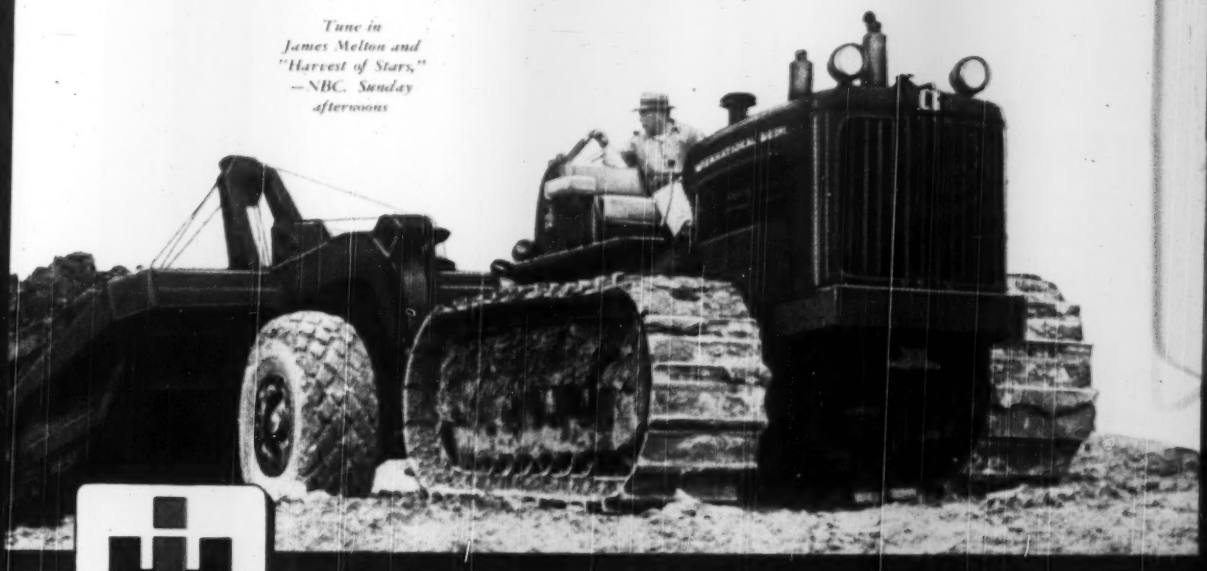
# of Crawlers

TRACTOR ON ANY JOB

● *"THE TD-24 is definitely outhauling every other tractor on the job. It will do so much work that we are sure our job costs will show a great saving!"* That's the report of the foreman on the 247,000-yd. University of Maryland stadium project. • *"I don't have to stop on any grade,"* the operator reports, *"and we have 25% or better on this job. Why, I just go up in 4th gear easy while the other tractors have to switch to low to make it."* And the TD-24 hauls a 17-yard scraper, heaped! • Yes, the TD-24 is the "workin'est tractor" on any job. Yet, its operator is the worker with the easiest day! See your International Industrial Power Distributor. Get a TD-24 demonstration. Discover how you, too, can save job time, cut costs, earn extra profits.

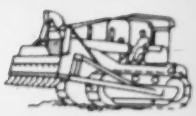
INTERNATIONAL HARVESTER COMPANY • Chicago

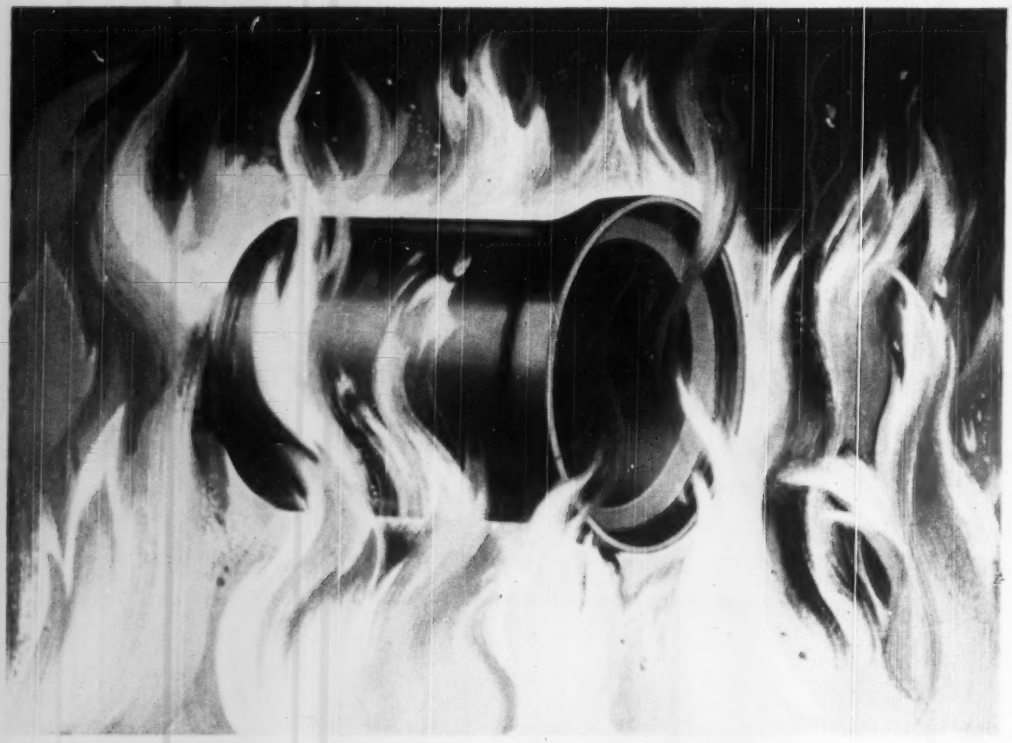
Tune in James Melton and "Harvest of Stars," —NBC. Sunday afternoons



INTERNATIONAL HARVESTER

INTERNATIONAL
INDUSTRIAL POWER





CLAY PIPE...fused by fire for EVERLASTING service

VITRIFICATION — the heat-bonding process that makes Clay Pipe tough, corrosion-proof, and everlasting — takes place at temperatures exceeding 2000° F. Under carefully controlled firing, the minute particles of rock that have been formed into Clay through centuries of nature's purification are fused *permanently* together. Vitrified Clay Pipe needs no coating to protect it from the corrosive action of sewage, ground waters, soils, or industrial waste. It's chemically inert, completely safe from the acid attack that destroys so many materials. No other pipe offers all the *necessary* advantages of Vitrified Clay Pipe. That's why it's universally preferred for sewerage and drainage installations.

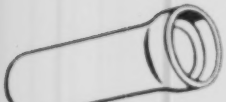
NATIONAL CLAY PIPE MANUFACTURERS, INC.

1105 Huntington Bank Bldg., Columbus 15, Ohio
703 Ninth and Hill Bldg., Los Angeles 15, Calif.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
206 Connally Bldg., Atlanta 3, Ga.

SPECIFY

Vitrified

CLAY PIPE



STANDARD-STRENGTH CLAY PIPE

CHANNEL CLAY PIPE

CLAY PIPE FITTINGS

C 350-2

Where profits talk

"CAT" EQUIPMENT SPEAKS YOUR LANGUAGE

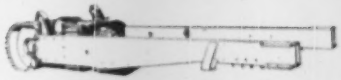
To the earthmoving contractor profits are mighty important. And a tractor-scraper outfit like the one shown here offers many ways of *boosting* profits. They're the kind of profits that show up in lower costs per yard, in more yardage per hour, and in more lifetime hours per machine.

Consider the DW10 alone – one of the greatest successes in heavy wheel tractor history. Look at the work-capacity features and the honest-to-goodness quality "Caterpillar" has built into it. (Nothing is too trivial or "too much trouble" to make these products the most profitable investments of their kind.) At the right are a few points of evidence.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

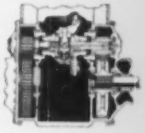
SPEED *PLUS* VOLUME. At up to 24.5 miles per hour go as much as 11 heaped yards of quickly loaded clay and gravel with this perfectly matched "Cat" DW10 Tractor and No. 10 Scraper. Scene is on road surfacing project near Brookhaven, Mississippi.

Profit IN STRENGTH



Main frame of the DW10—composed of two box-welded members securely fastened to transmission case—is 12 inches deep at rear (where load is carried). Has several times the resistance to twisting strains that channel sections of same size afford.

Profit IN QUALITY

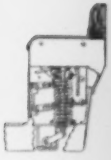


The DW10 embodies precision-built bevel gears, full-floating rear axle, crown-shaved "Hi-Electro" hardened final drive gears, welded steel transmission case, cast steel final drive housing, air-operated brakes.

Profit IN EASE OF OPERATION

Hydraulic booster steering gives the DW10 passenger-car turning ease; absorbs shock loads when taking rutted roads and downhill runs. Yet steering system is operative independently of booster feature. A valuable safety factor!

Profit IN OPERATOR COMFORT



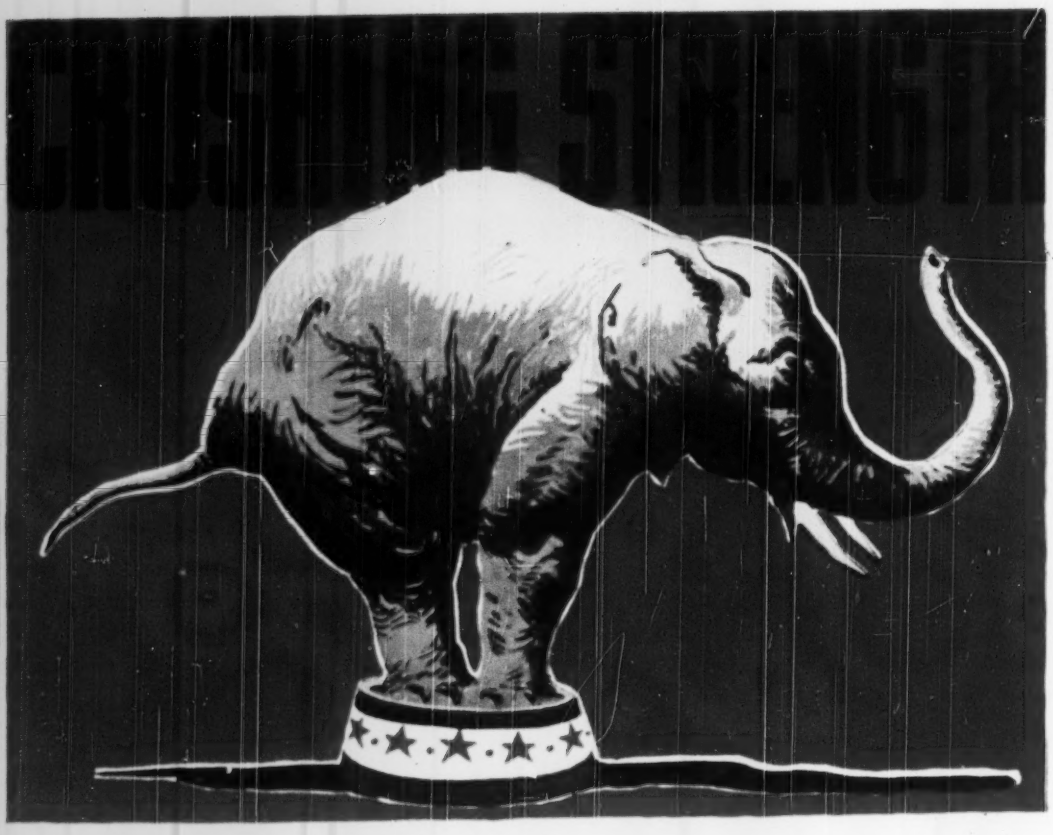
The DW10 is built for easy, safe driving. Besides finger-tip steering, excellent visibility and handy controls, the DW10 provides easy riding through air-foam rubber seat cushion *plus* seat springs that are adjustable to operator's weight.

SEE the NEW MOVIE FILM of "CAT" DW10s in ACTION at your dealer's. Fascinating. Convincing.

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT



Without crushing strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life !

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

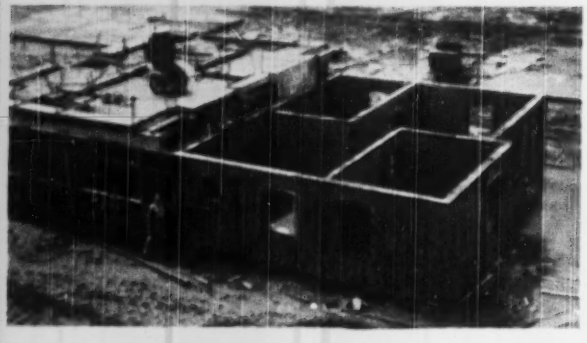
The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

SERVES FOR CENTURIES

IBEC MASS-PRODUCTION METHODS ACHIEVE NOTABLE HOUSING ECONOMIES



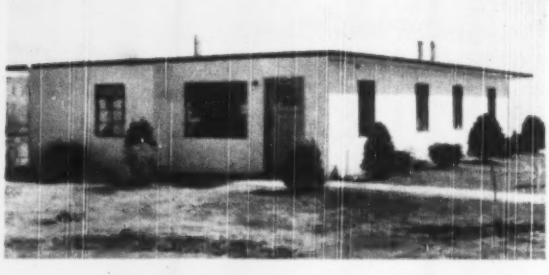
● Imagination and know-how, working with good concrete, have achieved another notable advance. Utilizing what in essence is a mobile production line on the job site, the Ibec Method produces attractive, all-concrete homes, at costs which revalue the home-building dollar.

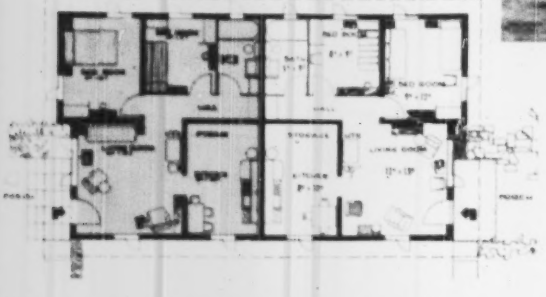
Heart of the Ibec Method is a 25-ton form used for both exterior and interior walls. A 30-ton crane positions the form on a cast-in-place floor slab. Roof slabs, precast on the ground in tiers, are placed on the house by Billner vacuum lifting device. Monolithic concrete walls in a single operation . . . no shoring, scaffolding, ladders . . . completing in hours what normally takes days.

Recent example is Marshall Manor, a 204-unit, low-cost housing project at Norfolk, Va., where attractive, fire-safe homes, built with Lone Star Cement and lightweight, insulating aggregates, rent for only $45. a month.

Here is Gibraltar-like, all-concrete construction—impervious to fire, termites, weather, wear. Adaptable to any good architectural design, the Ibec Method stretches the building dollar in the home-owner's favor.

MARSHALL MANOR, Norfolk, Va.
Built by **HENRY CLAY HOFHEIMER II**, Norfolk
Construction Method developed by
IBEC HOUSING CORPORATION,
Affiliate of **INTERNATIONAL BASIC ECONOMY CORP.,**
New York
Built with Lone Star Ready-Mix Concrete from:
SOUTHERN MATERIALS CO., INC., Norfolk—Richmond





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• *In This Issue*

Canadians Build World's First Aluminum Arch Bridge — *C. J. Pimenoff* — 17
Over-All National Water Policy a Necessity — *W. W. Horner* — 22
Dry Ice Creates Frozen Cofferdams for Bridge Pier Repair — *A. J. S. Taunton* — 24
Winter Concreting Can Be Economical — *Gordon Mitchell and R. B. Young* — 27
Interstate Commission Tackles Pollution Problem in Ohio River Valley — *Edward J. Cleary* — 32
Comprehensive Plant Survey Simplifies Problem of Industrial Waste Disposal — *Frank Woodbury Jones* — 34
Canada's First Subway Features Easy Transfer from Surface Transportation — *W. H. Paterson* — 36
Owner-Contractor Cooperation Cuts Toronto Subway Construction Costs — *Charles B. Molineaux* — 39
Shoran—Electronic Tool for Control Surveys and Mapping — *J. L. Rannie* — 42
Design of Dam Outlet Trash Rack Verified by Model Tests — *M. B. McPherson* — 46
Tunnel-Driving Alignment Speeded by New Method — *F. K. Matejka* — 47

• *Society News*

ASCE and EIC Have Joint Meeting in Toronto, July 12-14 — 51
Board Actions at Toronto Summarized — 53
Council of Engineering Secretaries Meets in New York — 54
Tellers Canvass Ballot for 1951 ASCE Officers — 54
Exploratory Group Reports Progress on Unification of Profession — 55
From the Nation's Capital — 56
ASCE Hydraulics Division to Have Jackson Meeting — 58
News of Local Sections Briefed — 58
Student Chapter Notes — 59

• *News Briefs*

Soil Testing and Metals Research Featured on ASTM Technical Program — 60
AGC Group Forecasts Record Construction Year and Keen Competition in Contracting Field — 60
Construction Starts on Chief Joseph Dam Project — 62
Government Predicts Record Outlays for New Construction — 62
Papers Sought for International Hydraulics Meeting — 62
Lake Mead Study Shows Small Reduction in Capacity — 64

• *Departments*

Engineers' Notebook — 46
The Readers Write — 49
N. G. Neare's Column — 68
New in Education — 72
Deceased — 72
News of Engineers — 75
Meetings and Conferences — 78
Recent Books — 79
New Publications — 82
Men and Jobs Available — 84
Equipment, Materials, and Methods — 86
Literature Available — 93
Index to Advertisers — 100

Proceedings Papers Available as Separates 95

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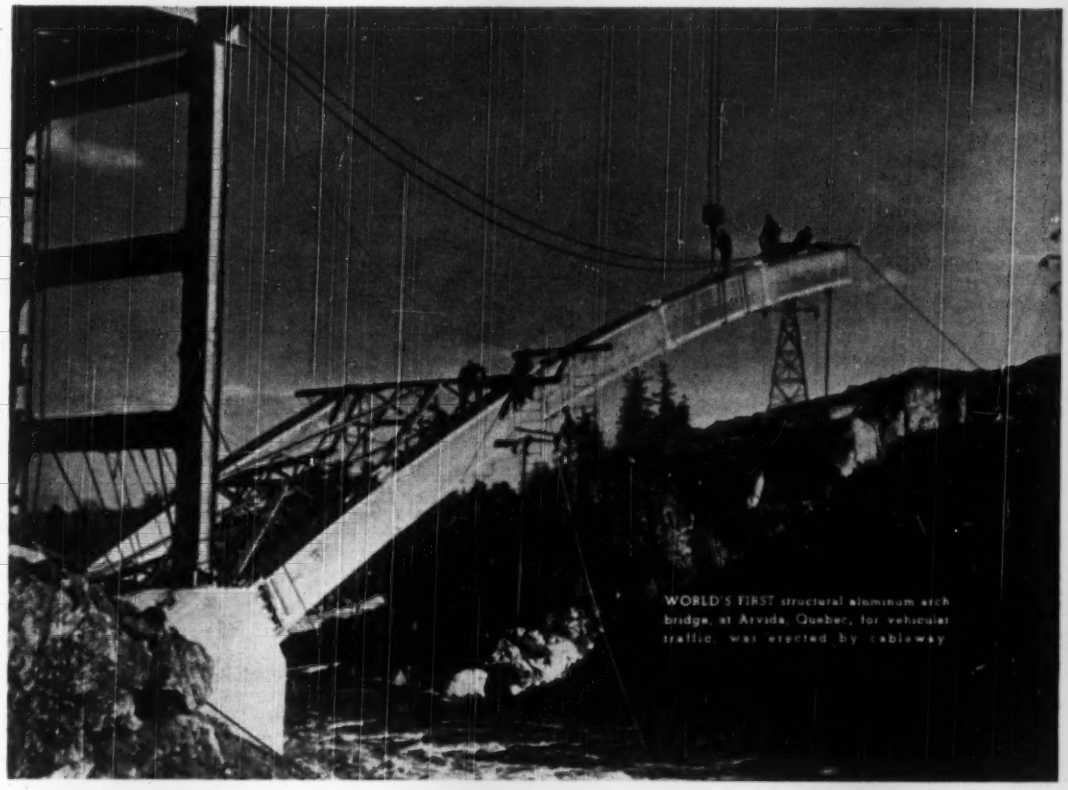


WORLD'S FIRST structural aluminum arch bridge, at Arvida, Quebec, for vehicular traffic, was erected by cableway

Canadians Build World's First Aluminum Arch Bridge

Special Techniques Developed for Fabrication and Erection to Meet Characteristics Peculiar to High-Strength Structural Aluminum

C. J. PIMENOFF, M.E.I.C.
Structural Designer, Dominion Bridge Co., Ltd., Lachine, Quebec

FABRICATION of structural aluminum for the arch bridge of 290-ft span over the Saguenay River at Arvida, Quebec, while similar to that of structural steel, nevertheless differs from it in a number of ways. Since high-strength structural aluminum (Alcan 26S-T) owes much of its strength to heat treatment, it cannot be subjected to temperatures above 350 deg F without sacrifice of strength.

Neither flame cutting nor welding can be used on structural aluminum. These limitations were frustrating at first. However, sawing was found to be so easy, in part because of the lightness of the metal, that it provided an excellent substitute for flame cutting. On the other hand, the inability to weld this aluminum alloy was always a handicap. There was no way to restore imperfect pieces, or to correct shop errors. This handicap was minimized by the high quality of the plates and shapes received from the mill and by the great care exercised in preparing the detail drawings and in the shop work. On the whole bridge, only a half dozen pieces were rejected.

Structural aluminum alloys lack the ductility of medium structural steel. The cold forming and bending of structural steel are facilitated by its high ductility, but with structural aluminum such operations can only be employed with caution. Typical stress-strain curves for steel and for aluminum alloys are given in Fig. 1.

It may well be that the limited ductility of aluminum does not make the finished structure any less safe. It is difficult to say just how much ductility is required to give a structure the toughness necessary to

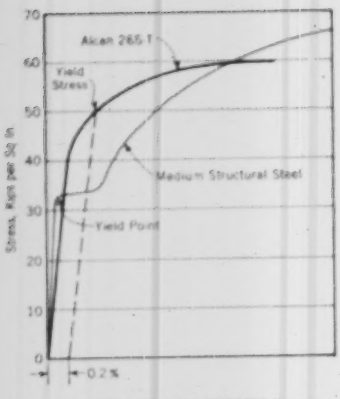


FIG. 1. STRESS-STRAIN CURVES for structural aluminum and for structural steel show that ultimate guaranteed strength of Alcan 26S-T about equals that of medium structural steel. Comparative lack of ductility of structural aluminum is also shown.

withstand shock and to make its component parts share the load evenly before failure occurs. The excellent performance of aluminum aeroplane structures seems to indicate that even Alcan-75S-T, with its 6 percent elongation, has adequate ductility for a structural material.

Other characteristics of aluminum alloys have a minor bearing on its fabrication. Because of its low modulus of elasticity (10,300,000 psi), an aluminum member will deflect three times as much as a similar steel one under the same load. To prevent undue deflection in drilling, for example, the work had to be better supported. Aluminum's thermal coefficient of expansion, being about twice that of steel, called for a correction to the measurement of long members with a steel tape when shop temperatures were appreciably higher or lower than normal.

Its light weight, about one third that of steel, facilitated handling. Most pieces were lifted and moved around by men instead of by power hoists. Since extruded shapes and Alclad plates possess good surfaces, aluminum members must be handled with care, particularly since the structure is not to be painted except for surfaces difficult of access after erection. Hemp-rope slings were used for lifting, and members were placed on wooden skids. Scribing was allowed only to indicate cuts, and center punching was used only on material to be punched or drilled out.

Fabrication called for better-than-average accuracy in shop work because of only $^{1}/_{64}$ in. diametral clearance between rivet and hole, and because field drifting and moderate forcing of members to fit, as practiced with structural steel, were thought to be inadvisable with aluminum. Greater accuracy in the shop work ensured proper fit during erection.

Sawing produced better edges than shearing and was used exclusively, although aluminum can be successfully sheared up to a thickness of $^{1}/_{2}$ in. Both plates and shapes were cut on a band saw with a blade speed of 1,200 fpm. The saw was lubricated with cutting fluid, and material was fed to it by eye to follow a penciled line.

Aluminum up to a thickness of $^{1}/_{2}$ in. can be satisfactorily punched as long as sharp-edged punches and neat fitting dies are used. Angles were punched; plates were stacked to a height of about 4 in. and drilled with high-speed twist-drills, generously lubricated with cutting fluid. Rivet holes, whether punched or drilled, were made $^{1}/_{8}$ in. smaller than the finished size of $^{15}/_{16}$ in. diameter and reamed to full size in assembly. The machinability of structural aluminum is excellent; operations on shapers and milling machines are fast and produce good surfaces.

Bending of plates was avoided as much as possible. Alcan 65S-T, $^{3}/_{16}$ in. thick, was cold bent through 90 deg in one operation; Alcan 26S-T, $^{3}/_{8}$-in. plates, were bent cold through 20 deg in a press, with better results when bending was accomplished in several stages. Some $^{1}/_{2}$-in. plates were bent cold and some were preheated to 350 deg F just before bending. Bending of arch-rib chord angles required some experimentation before the result was successful. The angles were bent in pairs to correct radius on the angle bending rolls by employing many passes with very gradual bending. When completed, they were relatively free from lateral bows and warping.

In the shop, prepared pieces were assembled with drift pins and bolts, but the men were cautioned not to damage the edges of holes. To keep out moisture and thus prevent the galvanic action to which this alloy is subject, one of the two contacting surfaces was brush coated with a sealing compound called Alumilastic to which 5 percent of zinc chromate had been added.

Aluminum alloy rivets of structural size can be driven either hot or cold. The fabricator's previous experience with hot-driven Alcan 17S-T rivets, both machine and gun driven, had been satisfactory but the driving of these rivets required much care and supervision, as they had to be driven within 10 seconds after being removed from a furnace which had heated them to within 10 deg of 940 deg F. Also, the work could not be allowed to heat up unduly. Realization of these conditions in the field was believed to be impracticable. Yet gun-driven, cold 16S-T rivets had not proved satisfactory.

Annular Rivet Head Developed

As a result of an extensive program of rivet driving and testing, carried out jointly by the Aluminum Laboratories and the Dominion Bridge Co., a new type of gun-driven rivet head, named "annular," was evolved and a special driving technique developed (Fig. 3). A $^{3}/_{16}$-in. hole, $^{3}/_{8}$ in. deep, is made in the end of the rivet, into which fits a projection on the snap of the gun. As the rivet is only $^{1}/_{64}$ in. smaller than the hole, the rivet shank is upset a minimum amount during driving. As the rivet is driven, the gun is rolled so that an annular head is formed. The average driving time for these rivets is about 40 sec each. The rivets are made from hot rolled and cold drawn Alcan 16S-T rod, which is of stable temper. Extruded rod is unsuitable. In the shop most of the rivets were machine driven with modified cone

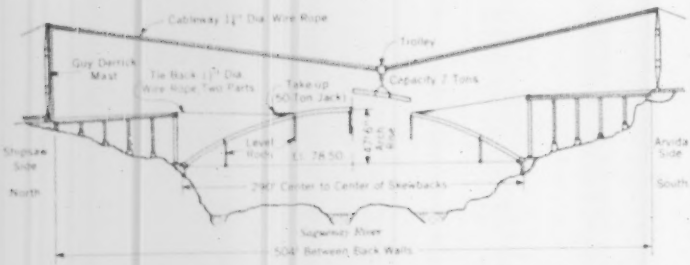
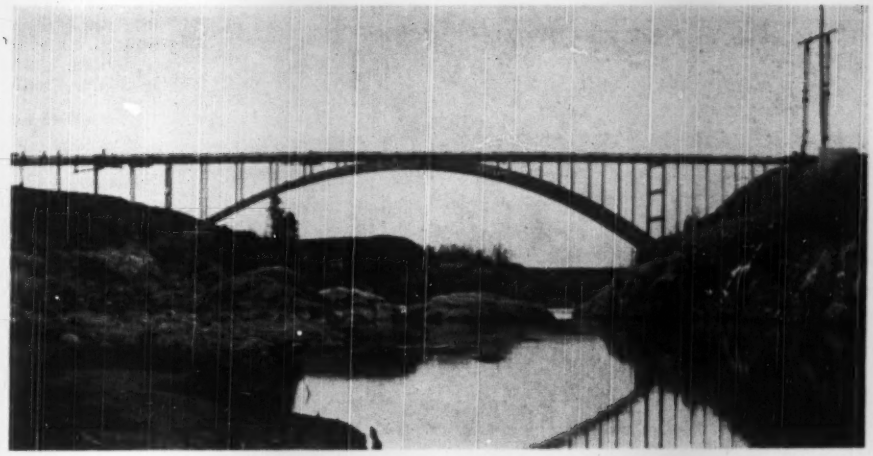


FIG. 2. CABLEWAY method of erection was chosen for Arvida Bridge largely because of lightness of heaviest rib section, which weighed 6½ tons.



ARVIDA BRIDGE, completed in June 1950, was erected by cableway. As arch ribs were cantilevered out, they were supported by tiebacks (see Fig. 2). When both arches were completed, cross braces were added, tiebacks slackened, and rest of field rivets driven. Tiebacks were then released to make arch self-supporting.

heads, but in places inaccessible to the machine, annular-head rivets were used.

Accurate Fabrication and Assembly Required

In a simple truss or girder span a slight error in length is of no consequence as one end of the bridge is free to expand. An arch, on the other hand, has to fit between two abutments, and any discrepancy between the actual span and the length of the fabricated superstructure would result in additional stresses. Close accuracy therefore was required in field surveys, in the construction of the abutments, and in the shop work.

In the shop the curve of the arch was laid out full size on the floor of the template shop and the ribs were built to it. Templates taken from the floor were used in marking the rectangular web plates to the correct curve, in subpunching holes in the flange angles, and in subdrilling holes in the web and cover plates. No effort was spared in the shop to produce a well fitting structure, and the reward was the ease with which the bridge was erected in the field.

The two 290-ft arch ribs were built in six shipping sections each, ranging in length from 19 ft at the springing line to 30 ft at the crown.

Web plates, stiffeners and flange angles were slabbed and bolted together, as were the cover plates and horizontal angles of stiffener frames. The four slabs were then boxed together to form a rib section, bolted, checked for trueness, and holes reamed in stiffener frames. The box was then taken apart and the component slabs reamed and riveted, after which it was reassembled, rechecked for trueness, reamed, and all riveted. All sections were made a little long, and the ends were later milled to the correct inner and outer chord lengths and bevels.

Rib splices were made as follows: The adjoining sections were butted together, fully bearing all around, and the chord lengths of combined sections checked. The subdrilled splice plates were positioned over the joint and the holes drilled in the ribs through the splice plates. All holes were then reamed and the shop splices riveted, giving six shipping sections per rib.

Each half rib was then completely assembled from springing line to crown and its chord length checked. The assembly was found to be nearly a half inch too long. Evidently the growth due to the riveting of shop splices, added to a slight overrun in the length of individual pieces, caused this build-up. Although this difference in the length of the rib was equivalent to a rise in temperature of only 22 deg F, it was decided to largely correct the length by machining $\frac{3}{16}$ in. off each end of all half ribs. Both ribs and bracing were completely assembled in three sections for the purpose of reaming holes for field rivets and of match-marking adjacent ends and splice material.

The floor system was similarly assembled in sections to the roadway profile. The center sections of the ribs and floor were all assembled together, since in the vicinity of the crown the arch ribs rise almost to touch the floor girders.

Shop Painting of Inaccessible Surfaces

Although the bridge as a whole was not painted, an exception was made for the inside surfaces of boxed members, which would be difficult of access after erection. These surfaces were cleaned with carbon tetrachloride, primed with a wash primer, and painted with aluminum paint. The interior of posts was given two coats and that of ribs one coat, the other coat to be applied in the field. The abutting ends were given only the priming coat.

In developing the scheme of erection two major decisions had to be made: whether to support the arch ribs, as they were cantilevered out, on timber falsework or by tiebacks, and

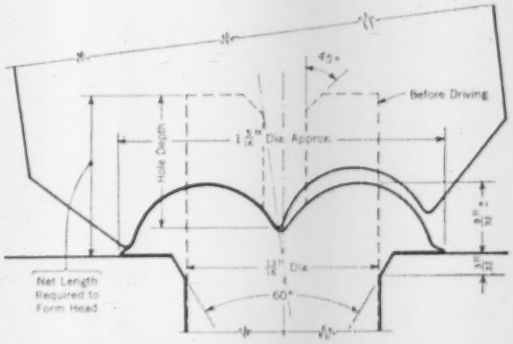


FIG. 3. ANNULAR HEADED RIVETS of 16S-T alloy, driven cold by pneumatic gun, were found best for field erection. As rivet is driven gun is rolled to form annular head.

ALUMINUM I-BEAM is split into tees with a Doall band saw, which operates at blade speed of 1,200 fpm. Both plates and shapes were sawed readily and good edges resulted. Re-entrant cuts were sawed into a drilled hole.

whether to handle the material with a traveler or by cableway. The two issues were interrelated. Using a traveler, the floor and posts would be erected along with the ribs, and it would be preferable to support the structure on falsework to avoid the expense of heavy tiebacks and anchorages. Using a cableway, only the weight of ribs and bracing would have to be supported, which could well be done either with falsework or with tiebacks.

Taking into account both the fact that the heaviest rib section, despite its 65-ft length, weighed only 6½ tons, and considering the company's recent and very satisfactory experience with cableway erection, it was decided to use the cableway rather than the traveling derrick. Tiebacks were used to support the arch ribs because the light weight of the ribs permitted light tiebacks and anchorages. Elimination of falsework permitted erection to be independent of the behavior of the river. Figure 2 shows the general scheme of erection.

Single Wire Rope Forms Cableway

The cableway consisted of a single 1⅛-in. wire rope spanning 516 ft between two guyed bents erected on the abutments. The bents were made of guy derrick booms and masts, the two legs of each bent being joined at the top with a cross beam. This beam carried a sliding cable saddle which enabled the cableway to be moved from side to side while working over either the upstream or the downstream rib. The north end bent was 90 ft high, and the south end bent 80 ft high, thus giving a comparatively level cableway. Maximum pull in the cable was estimated at 21 tons. Its ends were anchored in a trench in rock about 225 ft back of the bents. The load and the haul-in lines were worked by a steam hoist on the north shore; the lines for sliding the saddles were operated by hand winches.

Each of the four tiebacks was made up of two parts of 1½-in. wire rope, provided at the outer end with a take-up yoke operated by a 50-ton jack, thus enabling the rib to be raised or lowered as required during the various erection stages. Maximum pull on the tieback was estimated to be 40 tons, and the shore end was securely anchored in a trench in rock which was later filled with concrete.

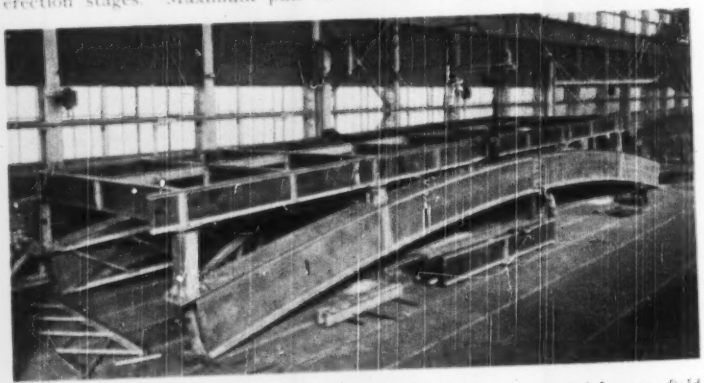
Rib Bases and Anchorages Placed

The first operation in the erection of the superstructure was the placing of rib bases and anchorages. The arch being fixed, each rib was anchored to the concrete abutments with fourteen 2-in.-dia bolts. To insure accurate placing of the anchor bolts and the four base plates, special frames were made for holding the anchors to the correct spacing and angle. These frames were hung from the ends of a temporary double girder which had been accurately placed on the partially poured abutment, leveled and anchored to the concrete. After the anchors were adjusted to correct position, the rest of the concrete was poured, except for a 3-in. space directly under the base plate which was grouted in after the base plate had been set to the correct angle.

The approaches were erected first. Full advantage was taken of the lightness of the material in assembling on shore complete floor panels and in erecting them as a unit. As erection progressed the north approach was boarded over, and acted as a working platform on which the bridge members were picked up by the cableway falls and then transported out to their destination.

Erection of Ribs

Each arch rib was shipped in six sections and the arch was erected as follows. The lower section of each half-rib was placed on the base and was cantilevered out, held by the anchor bolts. The intermediate section was then taken out on the cableway and lowered into position. While it was held by the cableway, its lower



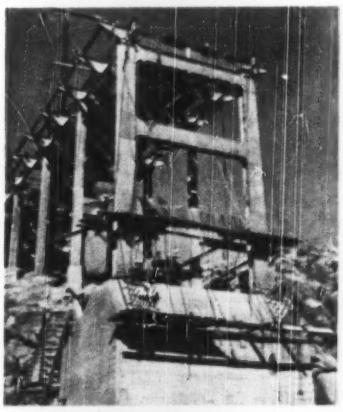
ACCURATE SHOP WORK and careful shop pre-assembly were rewarded by easy field erection. Here shop assembly of arch ribs and roadway at crown of bridge is seen.

end was spliced to the first section with temporary bolts and its upper end was connected to the tieback. The load was gradually transferred from the cableway to the tieback by simultaneously paying out the load line and pulling up on the take-up of the tieback.

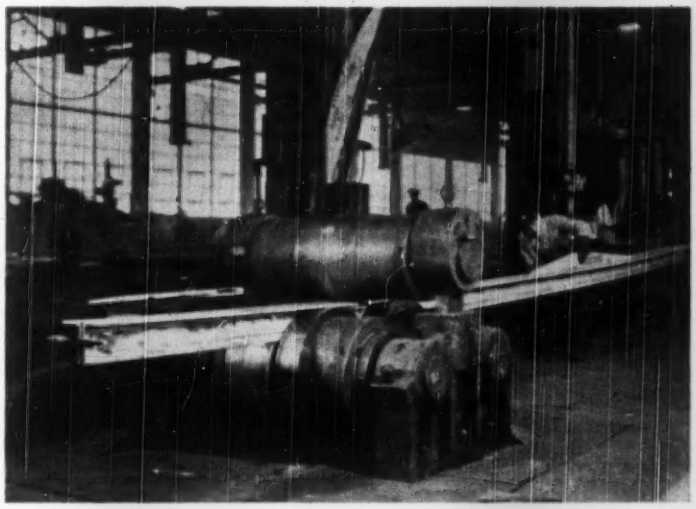
The harmony of the two operations was closely controlled to keep the upper end of the second section within predetermined high and low limiting elevations, computed to keep the stresses in the rib within reasonable limits. The elevation was indicated by a level rod suspended from the rib and read by a level on shore. The bracing was then erected and the field splice was riveted. The erection on the other shore was then brought to the same stage.

The third and last section of the north upstream half-rib was next moved out and spliced to the end of the second section. Again the tieback was pulled in as the load line was slackened, until the last section was fully cantilevered. The elevation of the arch rib was controlled by sighting at the level rod suspended from the rib at the crown (see Fig. 2). This operation was repeated on the downstream side and then the bracing was erected. The tiebacks now carried their maximum loads. To allow for a greater temperature shortening of tiebacks than of ribs, the latter were always left slightly low at night.

In the closing operation, the last section of the upstream rib was manœuvered into position and spliced at its lower end. At this time the arch crown was held a little higher than normal, resulting in an opening at the crown of $1\frac{1}{2}$ in. at the top surface of the rib and $1\frac{1}{4}$ in. at the bottom. All four tiebacks were then equally slackened until the joint at the crown closed at the bottom and was only open about $\frac{1}{8}$ in. at the top. This gap was easily closed by pulling the sections together with turnbuckles, and the crown splice was bolted up, after which the section was released from the falls. The following day the downstream rib was similarly closed, the bracing put in, and the tiebacks partly slackened, thus inducing some compression in the rib, which helped to close the joints and keep them tight. The splices were then riveted and, when finished, all four tiebacks were completely slackened off and dismantled and the arch became self-supporting.



IN CONSTRUCTION of one of approaches, each rib rests on precisely placed base plate anchored to abutment by fourteen 2-in. bolts, accurately set for exact location and slope of base plate.



ARCH-RIB CHORD ANGLES are gradually bent to correct radii on angle-bending rolls by employing many passes. Angles were examined under fluorescent light to detect possible minute cracks after bending.

The posts and the floor members were erected, beginning at the crown and proceeding simultaneously toward both ends. The longitudinal girders, which are continuous from one end of the bridge to the other, were closed at the splices just off the main bents.

After the annular-head rivet was developed and the technique of driving was improved, it was decided to field rivet the structure. The rivets used in the field were identical with the gun-driven shop rivets. One of the advantages of cold-driven rivets was that a loose rivet could be tightened simply by additional driving.

The erection of the approaches was started at the end of August 1949 and the riveting of the bridge was completed in the middle of December. Construction of the concrete deck was completed in June 1950.

The bridge superstructure, with the exception of the handrail, was fabricated in the Lachine plant of the Dominion Bridge Co. under the general supervision of R. Pearse, Works Manager, and Peter Millar, General Superintendent. The material was supplied by the Aluminum Co. of Canada. Many helpful suggestions and advice were received from K. Winslow, Structural Products Manager, Aluminum Co. of Canada. Rivets were made by Parmenter and Bulloch Manufacturing Co., Ltd., Gananoque, Ontario, and the handrail was fabricated by Lockweld & Forge, Ltd., of Montreal.

The bridge was erected by the forces of the Dominion Bridge Co. under the general supervision of W. P. Murray, erection manager, with F. Bowman as engineer-in-charge. Messrs. Surveyor, Nenniger & Chenerert were consulting engineers for the deck and foundations and the Pic Construction Co. Ltd., of Arvida, was the general contractor.

(This article is based on the paper presented by Mr. Pimenoff before the Structural Division at the Joint AIC-ASCE Meeting in Toronto. For this paper he was awarded the EIC's Gzowski Medal, a memorial to the late Sir Casimir Gzowski, one of the founders of EIC.)

Over-All National Water Policy a Necessity

W. W. HORNER, Past-President, ASCE
Chairman, Engineers Joint Council Water Policy Panel,
Consulting Engineer, St. Louis, Mo.

IF THE CONGRESS can be induced to review, redevelop, and clearly restate a consistent national water policy applicable to all classes of water use and control, most of the arguments for a federal department of public works on the one hand, or for covering the country with valley authorities on the other, would disappear. Then that whole question would be largely removed from the field of our national economy, and could continue to be discussed more specifically and properly in terms of political philosophy.

Much of the unsatisfactory and disappointing situation in the Missouri Basin, for example, might have been avoided, and no inconsiderable part may still be resolved, if the major policies and recommendations in the statements of the Coordinating Committee and of the Task Committees of the Engineers Joint Council Water Policy Panel had been in force and wholeheartedly accepted. Confusion and wasteful expenditures would have been checked if somewhere they had been subject to the scrutiny and test of impartial diagnosis and evaluation.

80-Man EJC Committee Develops Statement

In January of this year, the President of the United States appointed a temporary Water Resources Policy Commission, consisting of seven members. Two of these are engineers, one of them a member of ASCE. The others are economists, although two are also agriculturists and three are also college presidents (CIVIL ENGINEERING, February 1950, page 22).

Immediately thereafter, Engineers Joint Council, representing the country's five major engineering societies, instructed its Water Policy Panel to develop a statement of desirable water policy and to present it to the President's temporary Commission. The Panel recognized that any well-founded statement of this kind must be developed by a representative cross section of the professional membership. It communicated with more than a hundred of the leading engineers of the country, soliciting their cooperation. The response was almost explosive in character. Here at last was a chance to put down on paper constructive ideas of long standing, and for which previously no outlet had been available. A definite crusading spirit was apparent among them. The Panel's difficulty was to hold down the number of participants to a satisfactory working group capable of completing the task within a period of about five months.

The services of the 75 men accepted were organized into nine Task Committees and an over-all Coordinating Committee. The function of the latter was to reconcile differences, if any, between the nine primary sets of findings and to prepare a summary statement.

These individuals came into the effort with a full knowledge that it presented an opportunity for a major service by the profession to the public—an opportunity that could not be ignored. The members brought to the project a distinctly objective approach. It was interesting to see within the Task Committees the development of unanimous agreement as to essential basic principles, regardless of the fact that the individual members, in their personal affairs, presented a wide divergence of interests. The finished report presented to the President's Committee on July 1 consists of a foreword by the Panel, a summary statement of the Coordinating Committee, and the unedited statements of the nine Task Committees.

Many of the conclusions and recommendations of the Coordinating Committee's statement were abstracted in the July 1950 issue of CIVIL ENGINEERING. Some of the matters of general applicability are recorded in the following paragraphs.

"Contrary to general public belief" the Committee states, "there is no experience basis for fear that the availability of water resources, surface or underground, is declining. There is little evidence to support the prophets of doom in the water resources field. Intelligent husbanding and allocation are the keys to the future." The Committee has the strong feeling that, from the water resources standpoint, no part of the country is in such an undeveloped or overdeveloped state as to require neither thoughtful preparation and planning, nor equally thoughtful translation into action.

"Public money is limited in availability" reads the statement. Public needs such as for water, highways, schools and hospitals compete for it. Adequate evaluation and comparison of projects is a first requirement in national water policy implementation. In May 1950, Congress authorized construction of works for water resources development having an estimated cost of $1.8 billion. "No one, and least of all the President, was under the misapprehension that this authorization is sound with respect to wisest expenditure of public money." As of 1948, $5 billion worth of federal water development projects were

Recommendations of EJC Panel

1. A clearly defined national water policy should be established.
2. Intelligent allocation of water resources is the key to the future. The country's water resources are not declining.
3. Conservation and control of water resources should be done at the lowest practicable governmental level.
4. Projects should be self-supporting. Public money is limited in availability.
5. Adequate time should be allowed for collecting essential data and determining whether there is a real need for a proposed project.
6. Appraisal of costs should be realistic and in monetary terms, exclusive of intangible benefits.
7. Project costs should be repaid to the government by beneficiaries.
8. Federal water projects should be authorized solely by Congress.
9. No further Congressional authorizations should be made until a uniform national policy has been adopted.
10. Authorization should become void if the cost of a project overruns by 20 percent the cost estimated at the time of authorization.
11. Federal hydroelectric projects cannot reasonably be used as measures of economic efficiency, or of propriety of costs or rates for privately produced power.
12. The policy of using inland waterways as a regulatory agency to force reduction in land carrier rates should be abandoned.
13. Land utilization research should be instituted.
14. A board for impartial analysis of all federal water projects should be created.

under construction and about four times this amount will be required to build the works already proposed by federal agencies.

The Committee held that many of the authorizations already made were for undertakings which realistic diagnosis and measurement would disclose to be neither desirable nor warranted. "The present rate of planning and Congressionally authorizing water resources developments is excessive and economically unsound."

Panel Pleads for Land Utilization Research

The statement recognized that the objective of much of our water resources development is pointed directly at land utilization, and that in this field the federal government has no recognizable over-all policy but, on the contrary, many conflicting policies. This is a matter of critical importance to water projects which involve bringing additional land into agricultural production. The Panel recommended that a long-range research project be undertaken, primarily by capable agricultural economists, to determine the need, if any, for placing new lands under cultivation or for subsidizing a higher productivity of existing lands beyond that increase which is naturally occurring. This research would develop comparative facts which, when and if there is need for placing new lands under cultivation, will determine whether best over-all results to the national economy would be obtained from draining wet land, irrigating dry land, or improving the productive capacity of worn-out lands or lands of low natural fertility.

Professional Men Become Vocal

Engineers Joint Council Water Policy Panel is not the only professional group that has publicly expressed concern over the haphazard practices that have developed as the result of competition between federal agencies and Congressional response to pressure and trading. Many have watched with astonishment the breaking up of the traditional procedure for the planning and authorization of water resources development. In 1948 the National Water Conservation Conference presented a memorandum to the Hoover Commission which stated in part:

"The necessity for comprehensive, basin-wide development of the water resource is now fully recognized. This objective needs the guidance of clearly defined policies, principles and procedures established by Congress. This situation is recognized in Congress, and is fully understood by those who have had occasion to deal with the subject.

"Often action by Congress has been prompted by expediency, and by unrelated public demand from various parts of the country. The body of law regulating the activities of federal agencies in the water field has grown up like Topsy. The nation in this important endeavor has in the past proceeded, and at the present time continues to proceed, in a haphazard way."

The 1948 report of the Policy Committee of the American Water Works Association used the following language:

"There are competitive interests involved in the development of water resources, there are variable plans for development, conflicting financial methods which might be applied, and in some important areas insufficient water to go around.

"When to these complications are added the competitive interests and jealousies of individual states—and, at times, of parts of the same state—and of various federal agencies, the result is a situation of conflict which has been brewing for well over a century."

Board of Impartial Analysis Urged

The Engineers Joint Council Panel statement makes a clear distinction between the matter of basic national policy on the one hand, and the question of the character of administrative agencies on the other. Matters of administration policy are clearly separable from questions of fundamental policy and, in fact, should not be approached until after fundamental policies have been adopted." The Panel, however, does come out strongly in its statement for the creation of a Board of Impartial Analysis as suggested by the Hoover Commission. It believes that Congress should create such a statutory board, to review and diagnose undertakings in the water field in order to determine their wisdom, their economic feasibility and their priority, and that this is essential to the implementation of any water policy under any form of administration. It is just as necessary to coordinate the procedures of ten or fifty Valley Authorities as it is desirable to coordinate the activities of some ten federal agencies and related state offices.

Missouri Basin Plan Drawn in Haste

One example, the Missouri Basin development, was included in the statement because the Coordinating Committee believed that it points up most of the issues confronting proper water resources planning, utilization and management. The federal government is spending one billion dollars on the development of the Missouri Basin, but "from an engineering standpoint the planning and execution are almost entirely backward. The engineering features contained in the program were planned by various agencies restricted by law to limited objectives."

Geographic and land utilization characteristics and the needs of the Basin were ignored in determining which agency would develop the water resources in a particular field, the statement points out. "The Missouri Basin program was authorized by Congress in haste and without appropriate public hearings within the Basin. The severe floods of 1943 and 1944 were stated to be the prime motivator of the authorizations, although the plan, had it been in operation, would have contributed little to the alleviation of the storm and physical conditions that produced these floods. The time of the authorizations was opportune for such action, but Congress was faced with pressing demands of winning World War II."

A detailed and systematic inventory of the resources of the Basin was not available in the planning stages nor is such an inventory now completed. After the expenditures of several million dollars for topographic maps, sufficient maps are not yet available to make the detailed plans for irrigation projects in the Basin area for which Congress has made sweeping authorizations.

The upper reaches of the Missouri Basin are primarily interested in reclamation and secondarily in hydroelectric power; the middle and lower portions in flood control. Navigation is of little interest and of less significance even in the lower basin. After an expenditure of over $230 million on construction, maintenance and operation of navigation facilities, exclusive of Fort Peck Dam, the navigation savings from 1935 to 1948 were less than $4 million. "There is little wonder that the people of the Basin are unconvinced of the feasibility of navigation on the Missouri River," the report states.

The lack of sufficient hydrologic data is reflected in the controversies now prevailing over the availability of sufficient water to meet such functional uses as irrigation, hydroelectric power generation, navigation and stream pollution. No conclusive data have been presented to show there will be sufficient water impounded in authorized reservoirs to permit uninterrupted navigation and dilution of pollution when water allocated to irrigation is supplied to projects authorized and proposed.

(*Continued on page 85*)

Dry Ice Creates Frozen Cofferdams for Bridge Pier Repair

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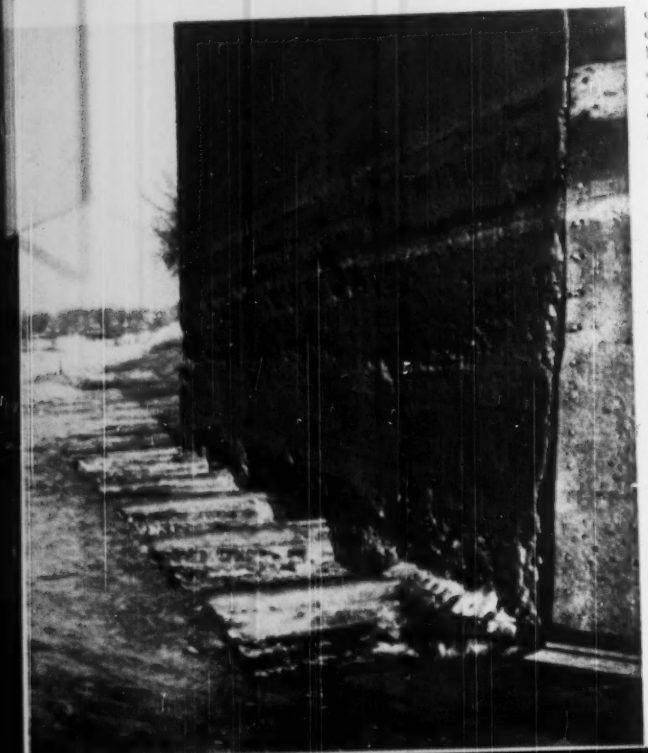
DRY ICE for the construction of ice cofferdams has been successfully used to repair several bridge piers in the City of Winnipeg. The method was developed when inspection showed large quantities of defective concrete in the piers of some of the city's old bridges. No thought was originally given to the possibility of using dry ice. However, as situations arose which did not lend themselves to the usual trenching and freezing technique, methods of artificially freezing the river water were developed.

Excluding the Norwood Bridge over the Red River, the Main Street Bridge over the Assiniboine River, and the Salter Street Viaduct, all the large bridges in Winnipeg were built thirty or forty years ago. At that time the art of mixing and placing concrete was decidedly haphazard. The water-cement ratio theory had not been developed and there were still engineers who maintained that concrete would not be seriously damaged by freezing and would set up all right when it thawed out.

The first intimation that below-surface concrete on Winnipeg's bridge piers might be defective was in 1945 when the bridge foreman on a routine inspection of the Arlington Bridge, built in 1910, noticed defective concrete at the surface of the ground. Further investigation showed that the concrete below the surface was in a deplorable condition—so bad that it could be picked out with the fingers, in many places to a depth of 2 ft. It is thought that the leaching of a lot of cinders, which had been placed on the surface around these piers, might have contributed considerably to the deterioration of the concrete.

One of the difficulties in concrete repair is to obtain a good bond with the old concrete. Another difficulty, caused by the shrinkage of the new concrete, is to get effective bearing when the new concrete is placed in a compression member. About the only remedy, using ordinary portland cement, is to leave a narrow space and dry pack it with concrete after the rest of the concrete has set and shrunk.



IN FIRST STAGE of repair work on pier of Winnipeg's old Redwood Bridge over Red River, alternate natural freezing and trenching are employed. Disintegration and spalling of concrete extended down to timber grillage (Fig. 1). Unusually low river level made it possible to excavate and freeze down to timber grillage without artificial refrigeration. Unexcavated bulkheads of ice in trench confine any water which may break through ice cofferdam.

Contract Awarded on Cost-Plus Basis

In this case, a process developed by the Intrusion-Prepakt Co., which had not previously been tried in Winnipeg, was used and a contract on a cost-plus basis was awarded to cover the Prepakt concrete construction. Demolition and all other work was done by the city.

The next bridge to be repaired was the Redwood Bridge over the Red River, built in 1908. The substructure consists of concrete piers in the river channel, in about 20 ft of water. The piers are carried on pile-supported timber grillages. Most of the disintegration of the pier concrete extended from about 3 ft above the surface of the ice down to the grillage—the belt most subjected to the action of alternate freezing and thawing. In some places the belt of damaged concrete had a depth of about 10 ft.

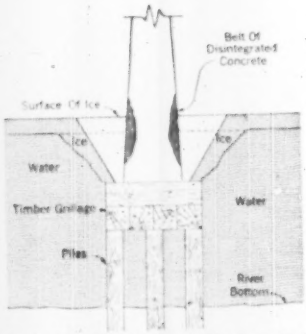


FIG. 1. REPAIR of damaged concrete on Redwood Bridge pier was effected at temperature of about 30 deg below zero by alternately trenching the river ice and permitting it to freeze naturally to greater depth. Damaged concrete extended from about 3 ft above surface of ice down to timber grillage, in belt having maximum depth of about 10 ft. pier surface subjected to greatest freezing and thawing action. On one pier where there was no projecting timber to work to, it was necessary to develop dry ice method for freezing to required depth.

SOLID ICE frozen by dry-ice forms cofferdam for repair of Elm Park Bridge pier. Method proved to be clean, effective and economical. As 48 hours are required to complete one freezing cycle, one side of pier is trenched while other side is freezing. Note ample space in enclosed work area. Total of 9,000 lb of dry ice was used at a cost 6 cents per lb.

Fortunately, during that winter the surface of the ice was lower than usual, being but 3 ft above the top of the timber grillages. As the temperature was about 30 deg F below zero, the procedure was to freeze down to the grillages by alternately trenching the ice and permitting it to freeze to a greater depth. (See Fig. 1.) The grillages, which consisted of a double layer of 12×12-in. timbers, generally projected about 12 in. outside the face of the pier, providing a good base for the forms when freezing had reached the required depth and the ice had been removed. The next steps were chipping out the defective concrete, placing expansion bolts to hold the forms, constructing the forms, and placing the reinforcing steel. The work was then enclosed in canvas and thawed out, and the Prepakt concrete placed.

Dry-Ice Method Developed

At the rear of one of the piers which was badly eroded to a considerable depth, there was no projecting timber to work to and the contractor was unable to freeze deep enough to make the repair at this point. The idea that dry ice might be used to freeze to the necessary depth evolved, and after a considerable amount of experimenting, the procedure was successfully developed and the repairs were completed. Similar erosion of concrete had taken place on the piers of the Provencher Bridge over the Red River and the contract was extended to include those repairs, which followed much the same lines as those at the Redwood Bridge.

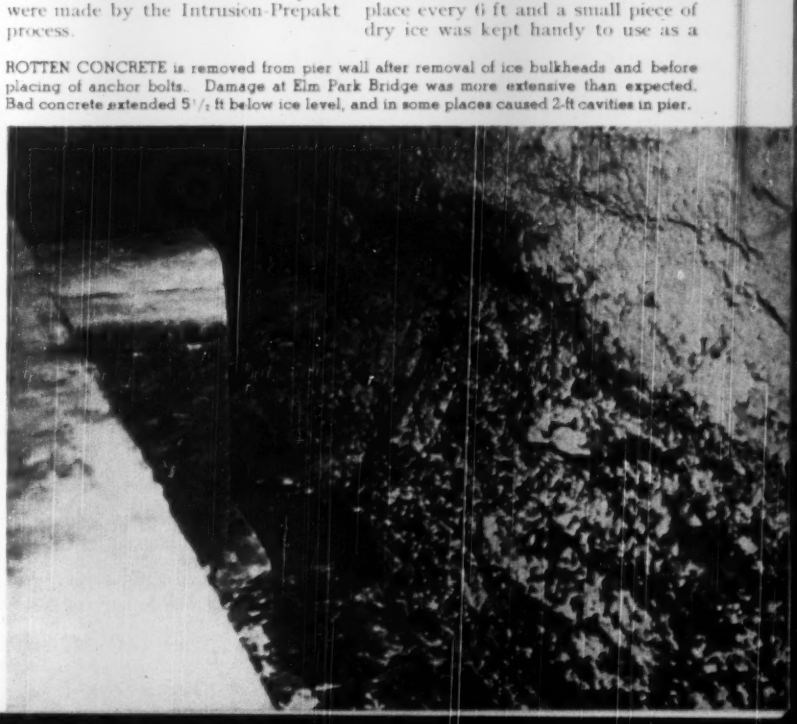
When the substructure of the Elm Park Bridge, built in 1911, was inspected, a considerable amount of concrete erosion on the two river piers around ice level was noted but it was not until this winter that authority to proceed with repairs was received. One river pier, having concrete foundations carried to rock, was to be repaired while the pivot pier was to be deferred as it is of large diameter, though considerable disintegration of concrete is indicated. The repairs were made by the Intrusion-Prepakt process.

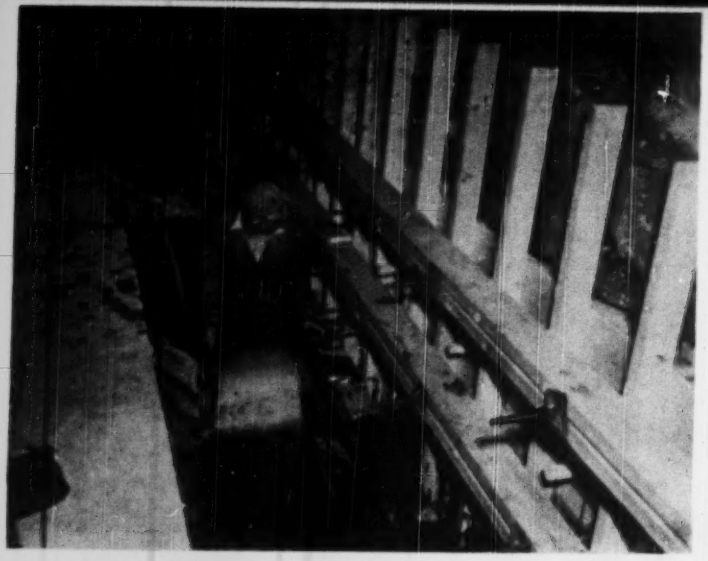
The first step was to build an access road down the south bank and to clear away the snow for about 30 ft around the pier. As is usually the case, it was found that the surface of the ice sloped down to the pier in the center, making the footing treacherous. The ice was flooded to provide a level surface, which greatly facilitated operations. The depth to which erosion of concrete extended below the ice was not known, but as it had extended the 3 ft to the timber platform on the Redwood Bridge it was expected to extend at least that deep at the Elm Park Bridge. This job was complicated by the fact that there was no wooden platform to work from, as the concrete piers were carried to rock.

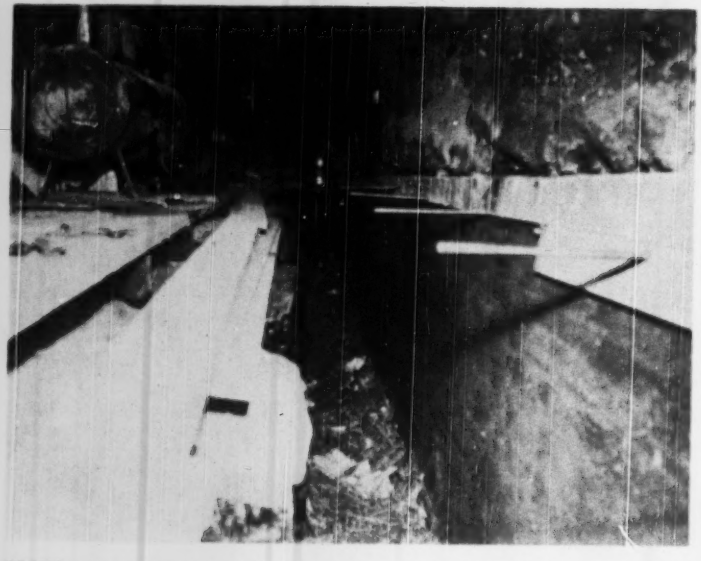
The common practice in making repairs at this depth would have been to build a cofferdam using timber sheet piling and puddled walls and to unwater to the river bed. The alternative was to form a cofferdam of ice by freezing to a depth of 6½ to 7 ft and excavating the ice to 6 ft, leaving a 6- to 12-in. floor of ice at the bottom. The latter method was followed, and dry ice was used to do the freezing. A very clean and effective job was done and a big saving was realized by using this method (Fig. 2).

The procedure was first to dig a trench in the ice about 3 ft wide. As the ice was only 10 in. thick, the first trench was quite shallow. To prevent the whole trench from becoming flooded by a break-through from the bottom, bulkheads of ice were left in place every 6 ft and a small piece of dry ice was kept handy to use as a

ROTTEN CONCRETE is removed from pier wall after removal of ice bulkheads and before placing of anchor bolts. Damage at Elm Park Bridge was more extensive than expected. Bad concrete extended 5½ ft below ice level, and in some places caused 2-ft cavities in pier.







GROUT is placed (upper photo) after watertight forms are constructed and expansion bolts are set. Note tapered wooden plugs which plug holes in form for grouting insert. Forms were filled with coarse aggregate, and steam was blown in until wall was well warmed before grout was pumped in. Lower photo shows finished wall of Prepakt concrete below ice level on pier of Elm Park Bridge.

plug should a leak develop. Dry ice was then placed in the trench.

The dry ice is solid carbon dioxide, having a temperature of about −110 deg F. It comes in 9 or 10-in. cubes wrapped in newspaper, each cube weighing 20 to 25 lb. The wrapping is removed and the cubes placed in the trench as expeditiously as possible. They are placed with a space of about 6 in. between them and are immediately covered with canvas, which is in turn covered with straw.

The dry ice does not liquefy and then vaporize, but changes directly from solid to vapor. In so doing, it absorbs from the adjacent ice and water the heat necessary to raise its temperature to that of its surroundings and also an amount of heat equal to the latent heats of both fusion and evaporation. One pound of dry ice will absorb about 260 Btu in attaining a temperature of 32 deg F. Care must be taken to see that no men become asphyxiated.

Three or four alternate trenchings and applications of dry ice at 2,000 lb per application were required to freeze to the necessary depth of $6\frac{1}{2}$ ft. About 9,000 lb of dry ice, costing 6 cents a pound, was used.

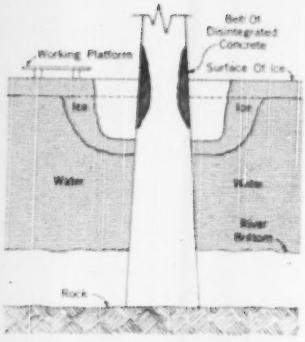


FIG. 2. ARTIFICIAL FREEZING of river water by dry ice formed ice "cofferdam" for repair of Elm Park Bridge pier. Area inside cofferdam was alternately packed with dry ice and trenched out to provide sufficient space for repairing damaged concrete of pier by Intrusion-Prepakt process.

As it takes as much as 48 hours under Manitoba winter conditions to obtain the full freezing effect from one application of dry ice, opposite sides of the pier were worked on alternately. While one side was being frozen, the other side was excavated.

When the ice had been frozen and excavated to practically the full depth, the whole area was enclosed in a canvas housing allowing enough room for working space and for operating equipment.

Before constructing the working platform, which stands about 1 ft above the surface of the ice, a thin layer of sand was placed on the ice to act as insulation and help to keep the ice from melting.

The ice bulkheads on the side of the pier and at the rear were then removed and the lower concrete cleaned and chipped back to a solid face. It was found that the condition of the concrete was much worse than anticipated. The damage formed a belt about 10 ft deep, extending to $5\frac{1}{2}$ ft below the surface of the ice, with cavities in the pier face as deep as 2 ft.

After the defective concrete had been removed, expansion bolts were set in place, reinforcing steel placed and watertight forms constructed. Holes of a sufficient size to take the grouting inserts had been bored and plugged with tapered wooden plugs. The forms were then filled with coarse aggregate, steam was blown in until the concrete backing was well warmed and the grout was pumped in.

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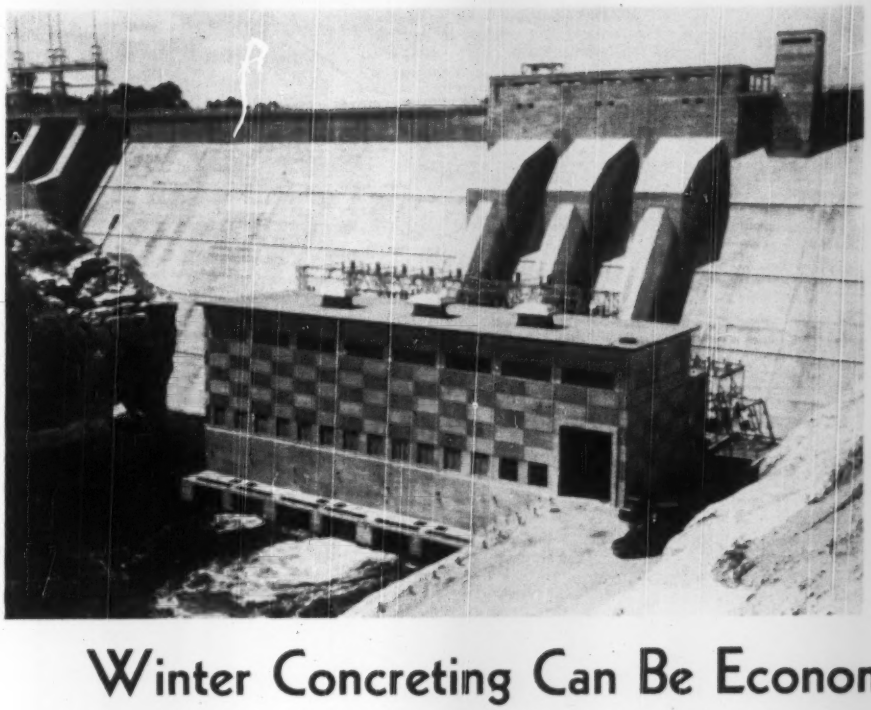

CONCRETING OF Stewartville Dam containing 273,700 cu yd of concrete continued throughout three winters using placement methods developed by Ontario Hydro-Electric Commission. Dam is 1,300 ft long and 190 ft high above foundation at deepest point, and was poured in lifts 30 to 50 ft high. Cold-weather procedures increase mass concrete costs about 8 percent in Ontario.

LARGEST of Ontario Commission's hydro developments is Des Joachims, illustrated on cover. Two of its eight 60,000-kw generators were put on line late in June.

Winter Concreting Can Be Economical

Efficient Methods Developed for Large-Dam Construction in Canada

GORDON MITCHELL and R. B. YOUNG, both M. E.I.C.

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WINTER CONCRETING is almost a "must" on jobs of any size in Ontario, because of climatic conditions. Records for the province, except for its southern part, indicate that the average mean temperature is less than 32 deg for six months of the year. For three of these months it is under 10 deg F, and for the month of January it is below zero. To stop construction in winter would mean a shutdown each year of at least five months, a procedure estimated to be more costly than working continuously. Therefore, work goes on apace regardless of temperature.

Huge Program Under Way

At present, the Hydro-Electric Power Commission is engaged in a huge program of hydro and steam power-plant construction. Most of the developments in the program will require three to four years for completion and all together they will use more than 2,500,000 cu yd of concrete (880,000 cu yd in one development alone). Provision has had to be made for extensive concreting in winter.

Heat is one of the major requirements for winter concreting—heat for the various buildings used, heat for aggregates and water, heat for thawing out forms, and heat for protecting concrete after placement. The kind of heat adopted for all these uses is steam heat, either wet or dry. A boiler plant is therefore a necessity. The installed horsepower required for concreting is for all practical purposes in direct proportion to the mixing capacity of the concrete plant. On Commission jobs it has worked out as a rule of thumb that for every yard of mixer capacity 100 hp of boiler capacity is required. This quantity is for construction steam only and does not include steam for shops, camps and other auxiliary services.

In general, the Commission provides ample heat for sustained temperatures of 20 to 30 deg F below zero. There is nothing that slows up a concrete program faster in winter than lack of heat. Where possible, all boilers are concentrated in a single building.

Bunker C oil is probably the most practicable fuel at present because it does not require the large storage areas needed for coal and it is not as expensive as light fuel oil. A shortage of electrical energy precludes its use for heating at present.

Bunker C oil is shipped in tank cars equipped with steam coils and, where possible, the boiler plant is located on a railway siding at the job so that there is no difficulty in providing the necessary heat and facilities for handling the oil.

All boiler plants now in use by the Commission on construction jobs are operated at 100 psi steam pressure. If lower pressures are required for other operations, pressure-reducing valves are installed. Steam at 100 psi is used for concreting because the nature of the work demands much changing of lines so that lines must often be left exposed. Where steam lines are permanently located, the insulation is usually asbestos. Steam

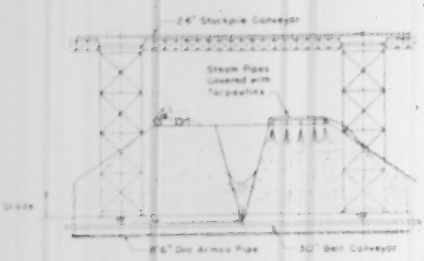


FIG. 1. SAND for concrete is heated in winter by tarpaulin-covered steam jets inserted at top of pile. Bulldozer pushes previously heated sand to gate over belt conveyor leading to mixing plant.

mains are usually hung from brackets at the top of short poles so that where they cross roads there is as little interference with traffic as possible. In other locations they may be located inside a continuous box built at ground level and insulated with sawdust or shavings.

Conveyors and Mixing Plants Are Housed

On some Commission jobs conveyors have been installed to handle aggregate from stockpile to mixer and concrete from mixer to forms. These conveyors must be housed and the housing heated for efficient operation. Thus the convenient way to carry steam mains to forms is along such a conveyor housing. All conveyors operated in the winter are housed and heated except for very short aggregate conveyors which will operate satisfactorily even at 30 deg F below zero, if the head and tail pulleys are protected.

Water mains to the mixer plant are usually heated by running a steam main alongside, wrapping both with asbestos paper, and housing them in a box insulated with sawdust or shavings. For long water lines, a low-voltage hot-bed cable has been used successfully to prevent freezing. The cable is placed spirally around the pipe, which is then wrapped with asbestos paper and located in an insulated box. A hot-bed cable must be kept hot all summer to prevent the insulation from becoming damp and causing a short circuit.

The Commission has several large-capacity mixing plants that are completely housed from top to bottom, including the bins. It is especially important that steel bins be housed. Steam unit heaters are the common method for heating a mixer plant. The required number are placed near the base of the building and the heat is allowed to rise to the various floors and finally to circulate around the bins.

Where aggregate is obtained from gravel or sand deposits, all screening and separating is done in mild weather, starting early in the spring. If there is to be a heavy concrete program during the following winter, ample stocks of aggregate must be provided before freezing weather sets in. Stockpiles are generally placed in a straight line along a tunnel through which the aggregate is reclaimed.

For winter concreting, only the sand and water need be heated. In late fall, with temperatures a little below freezing, only the water is heated. Later, as the weather becomes colder and the stockpiles freeze, heat is applied also to the sand.

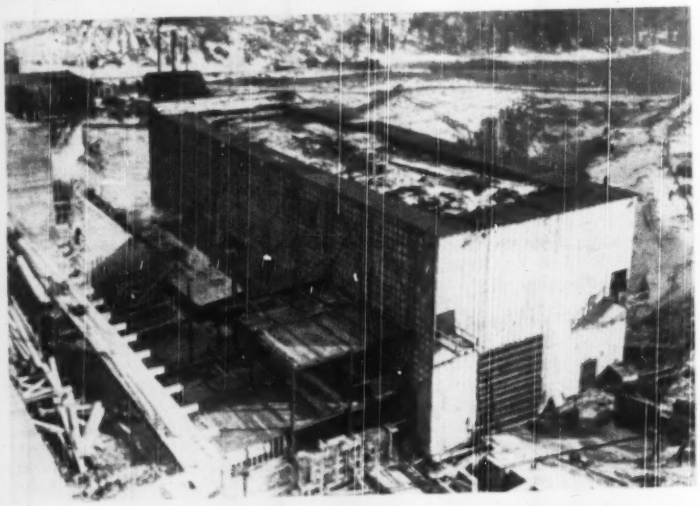
The most economical and satisfactory method so far found for heating sand in quantities of 120 tons per hour and more is by steam jets (Fig. 1). When the sand is reclaimed by a conveyor operating in a tunnel under a stockpile, jets are inserted at the top of the pile and tarpaulins spread over the sand in order to maintain a more uniform distribution of heat and to prevent the formation of crusts. When hot, the sand is bulldozed to above the gate feeding the reclaiming belt. Since the piles are large, jets can be used at several points so that plenty of sand will be kept heated.

Heating at the top of the pile produces a sand which is free from frozen lumps and comparatively dry because of the excellent drainage in the pile itself. This method provides better control of the water content of the sand, and hence of the concrete. When concreting is not in progress the steam can be turned off. Where sand is reclaimed by shovels, steam jets are inserted in the working face of the pile and the hot sand is loaded into trucks and delivered to a hopper feeding a belt conveyor.

For automatic mixing plants having capacities up to 160 cu yd of concrete per hour, a large quantity of water has to be heated using steam coils and jets. An enclosed wood-stave tank with a capacity of 7,000 to 10,000 Imperial gallons is usually built adjacent to the mixer plant, high enough to feed to the batching floor by gravity. Submerged steam coils are placed in the bottom of a tank of sufficient capacity to provide all the hot water needed for maximum plant output (Fig. 3). Hot water is taken off near the top of the tank and cold water fed in at the bottom, water levels being controlled by a float valve.

The temperature of the water is regulated by a thermostatically controlled steam valve which usually has an operating range of 100 to 140

COMPLETE HOUSING of powerhouse superstructure permits concreting to proceed efficiently during Canadian winter. Heat used is steam exclusively and fuel is generally Bunker C oil, which does not require large storage area needed for coal and is cheaper than light fuel oil.



deg F, but temperatures up to 180 deg F are used when necessary. By adjusting the heat of the water, the concrete on discharge from the mixers can be maintained at a reasonably uniform temperature regardless of outside conditions or the heat in the aggregates. For most work the temperature of the concrete when placed should be low to avoid excessive heat during setting. There is nothing to be gained and much to be lost if concrete is placed at a temperature higher than necessary. The minimum temperature at which concrete should be deposited is considered to be 40 deg F, but most of the concrete is placed at around 50 deg F, and for reinforced concrete even higher temperatures are used.

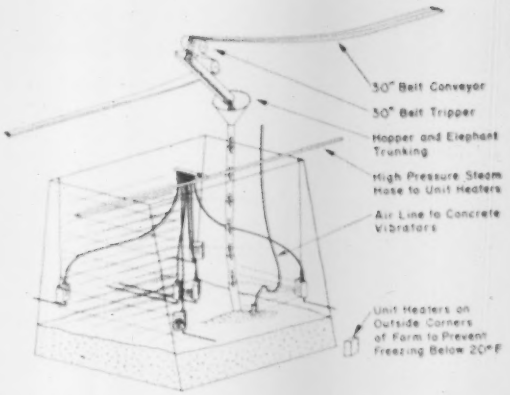

30" Belt Conveyor
30" Belt Tripper
Hopper and Elephant Trunking
High Pressure Steam Hose to Unit Heaters
Air Line to Concrete Vibrators
Unit Heaters on Outside Corners of Form to Prevent Freezing Below 20°F

FIG. 2. FORMS FOR continuous winter pours up to 50 ft in height and containing 2,000 to 15,000 cu yd of concrete each, are warmed by steam heaters suspended inside. For temperatures below 20 deg F, forms are completely housed with flame-proofed tarpaulins.

Precautions for Transporting Concrete

Transportation of freshly mixed concrete in winter presents no particular problem. If it is moved by belt conveyor, the conveyor is housed in a heated building for its entire length. If it is moved by truck, no attempt is made to cover the surface of the concrete unless the haul is more than a mile or unless the temperature is well below zero. For longer hauls and lower temperatures, tarpaulins are spread over the concrete. This winter on one job the Commission hauled 42,000 cu yd of concrete three miles in rear-dump Euclid trucks without difficulty. For short hauls, when transportation is by buckets on trucks, no protection is required. For long hauls and excessive delays, it may be advisable to provide heated housing on the truck, with heat supplied by an oil stove.

Where concrete is pumped, there is little loss of heat in the pipelines if the concrete is kept moving, and except in the very coldest weather, the pipelines need no protection. However, if pumping has to be stopped on account of delays at the forms, freezing may occur and block the pipes, so that protection is advisable for lines that are to be in use over a considerable period. If the Pumpcrete line is short, tarpaulins wrapped around the pipe and a steam line laid alongside will provide adequate protection. For longer or more permanent lines, a continuous box is built around the pipe with removable top and sides, and a steam line is installed inside. It is important, when using Pumpcrete in winter, to inject live steam into the line before starting to pump. Unless this is done, the first concrete pumped gradually freezes as it progresses along the line.

COMPLETELY HOUSED AND HEATED belt-conveyor feeds concrete to upstream face of LaLave Dam on Ottawa River, during January 1950. Conveyor is mounted on Bailey bridge trestle.

Forms Built for 50-Ft Lifts

For twenty years the Commission has followed the practice of eliminating as many horizontal joints as possible in its concrete structures. Concrete is placed in lifts as high as 50 feet, necessitating forms of like height, and to fill them requires the continuous placement of anywhere from 2,000 to 15,000 cu yd of concrete (Fig 2). The sheathing in these forms is usually $\frac{3}{4}$-in. plywood, or 1×6-in. dressed dry lumber. Where plywood is used, it is not necessary, except on cold, windy days, to cover the forms with tarpaulins, but this protection is necessary with lumber forms. When tarpaulins are used they are made as tight as possible and the number of openings between them is reduced to a minimum.

A wooden working platform is built at the top of the form and covered with tarpaulins which drape over and are fastened to the side forms. This platform is built approximately 6 ft above the ultimate level of the concrete in the forms to provide adequate working space when the concrete reaches its full height.

Salamanders Are Banned

Unit heaters are used exclusively inside the forms. Salamanders, oil stoves and other potential fire hazards are absolutely banned. All unit heaters are connected by steam hose both at inlet and at outlet and are hung with light block and tackle from supports above the form in the housing. They are first placed at the bottom of the form to be used in conjunction with steam jets in providing

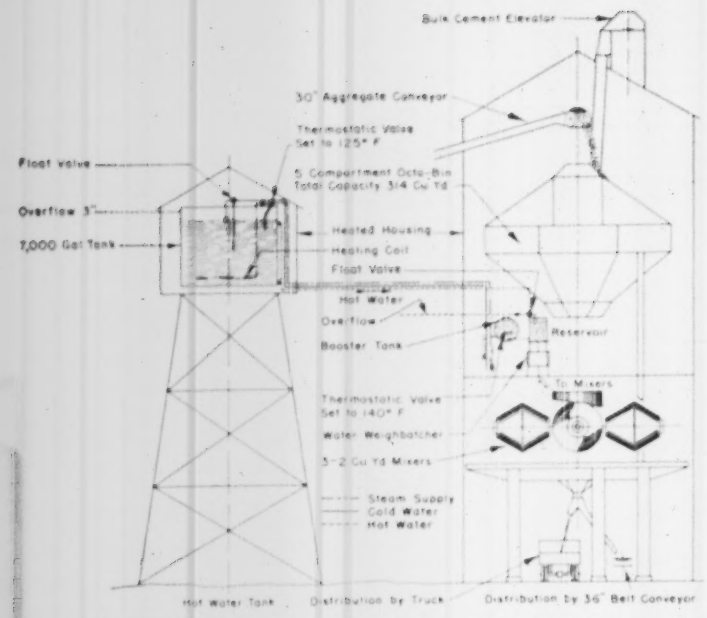


FIG 3. CONCRETE PLANT for freezing weather produces 160 cu yd per hr for placement at optimum temperature of 50 deg F. Mixing water is heated to 100 to 140 deg F but temperatures up to 180 deg are used when necessary.

heat for general clean-up of ice and debris before concreting starts. As concreting progresses and the level of the concrete in the form rises, the unit heaters are raised so that when placing ceases, they are in a position to protect the surface of the concrete.

Since the unit heater has to be pulled in and out between reinforcement and through falsework, a good practical size has a weight in the neighborhood of 190 lb. Such a heater, with an E.D.R. (equivalent direct radiation) of 600, requires about 8.4 boiler hp of steam to operate. From six to twelve of these heaters are used in a form, depending on its size.

Winter Curing Also Requires Moisture

Concrete requires moisture for curing, whether in winter or summer, and with the dry heat used for frost protection, exposed surfaces must be kept moist. The exposed concrete is constantly wet down and sometimes a layer of sand is spread over surfaces to prevent too rapid evaporation. Curing has also been done with wet steam introduced into the working space above the concrete, but with this method tarpaulins and woodwork eventually become heavily coated with ice. Tops of lifts are protected for at least 72 hours and side forms are left on as long as possible, usually for three to four weeks.

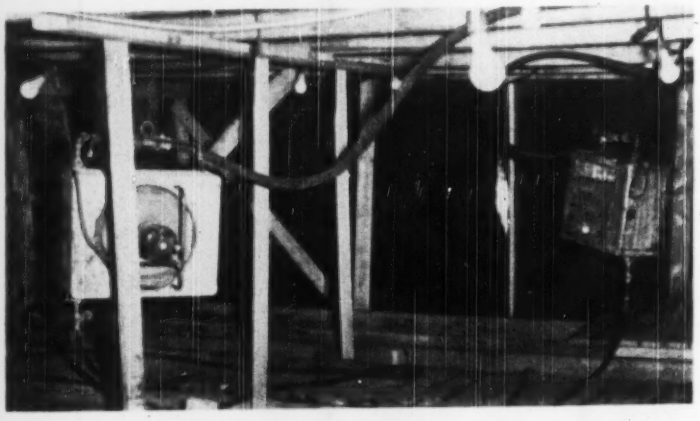
The heat generated by mass concrete during the first few hours of hydration is not sufficient to protect it from freezing. In moderately cold weather, the forms will protect the concrete behind them from freezing but fresh concrete surfaces in contact with air need protection for at least 72 hours before exposure to freezing temperatures.

Wind, temperature, type and design of forms, and degree of housing are all factors in determining where, when and how much protection is needed. Although heat costs money and should be conserved where possible, the primary consideration is the safety of the concrete. To aid judgment and to ensure adequate protection at all times and under all circumstances, the Commission's jobs are equipped with recording thermometers and thermocouples to give exact information on the temperatures actually existing in the concrete, forms and enclosures. Corners and edges are the most vulnerable. With a wind blowing and the temperature dropping, special precautions need to be taken, but forms give a great deal more protection than is generally supposed.

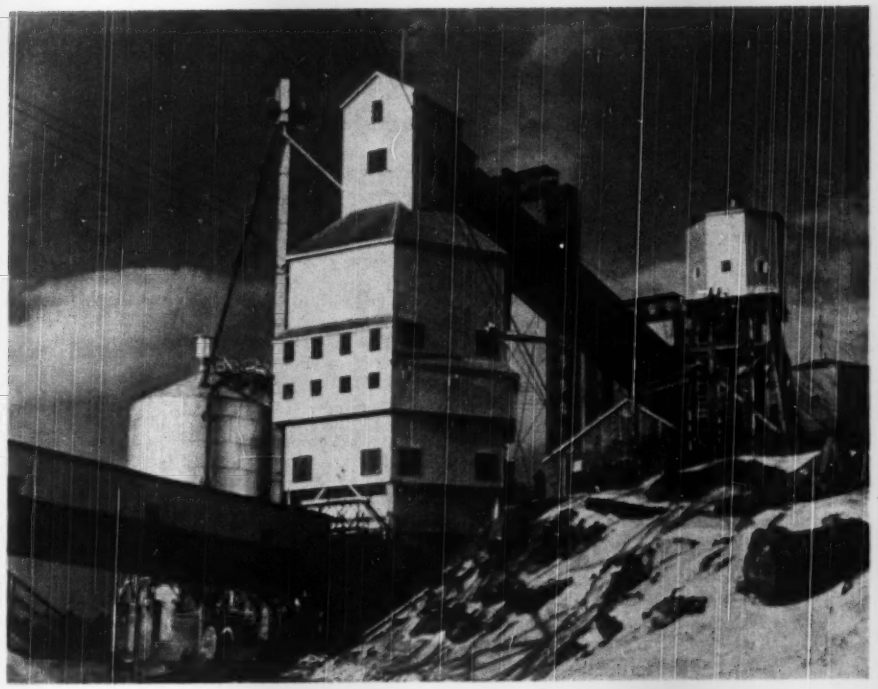
For concreting thin wall sections of small yardages, housings of tarpaulins are built to completely envelop the form. Where numerous small quantities of concrete are to be placed in the same general area, such as in a powerhouse, a housing large enough to include all the ultimate forming is built and heated, thus providing excellent working conditions and adequate protection. Bailey bridging, modified as necessary, has been found a very convenient support for such housing.

Fire Protection, an Important Precaution

One of the important points to consider when planning for winter protection is the fire hazard. Fires may arise from welding and cutting operations, but most of the fires in form work have started in tarpaulins.



UNIT STEAM HEATERS are placed on top of dam forms in temporary housing of flameproofed tarpaulins to protect fresh concrete from freezing for 72 hours after pouring.



WINTERIZED CONCRETE PLANT at Des Joachims Development on Ottawa River (Fig. 3) has capacity of 160 cu yd per hour. Water tank, right, mixer plant, and concrete conveyor belt, left, are completely housed. Note extensive use of Bailey bridging to support conveyors.

During the recent war, the Armed Forces developed a liquid that can be used to flameproof tarpaulins, and for the past four years the Commission has permitted only tarpaulins so treated to be used. Spraying a tarpaulin does not make it flameproof; it must be impregnated by complete immersion in the liquid. For ease in handling, tarpaulins are generally 12×12 ft or 12×16 ft in size.

Fire hose is located close to all form work and buildings. If a conveyor is used for distributing concrete, a water main, exclusively for fire protection, is placed in the conveyor housing. If there is danger from freezing, the fire main is kept drained and is controlled by a valve protected from freezing but easily accessible. A standby fire pump, usually located at the main water tank and connected directly with the water line, provides pressure. At an isolated location an auxiliary standby pump is installed to take water from the river on which the development is being built.

All housings for mixers, conveyor belts and forms are thus protected by fire lines, with hydrants and adequate hose located inside structures as well as out. Also, a generous supply of hand extinguishers is always available in every building. To prevent the spread of fire in buildings containing conveyor belts, fire walls are built at frequent intervals. Wooden trestles located adjacent to form work are treated with fire retarding chemicals. A fire brigade, headed by a fire chief reporting directly to the Construction Superintendent, is organized on each job. Members of the brigade are usually taken from the mechanical staff. On larger jobs, the fire chief's sole duty is the prevention and fighting of fires. He constantly checks hose, fire extinguishers, and water lines. A fire truck equipped with water tank, pump and hose is also available, and a man is constantly in attendance. Where a great deal of form work is being built, a guard is on duty at all times to watch for fires and put them out if possible. This precaution is particularly important when workmen are away for meals. "No Smoking" rules are also in effect.

Winter Concreting Costs 8 Percent More

And now a word about costs. Obviously concreting in winter costs more than in summer since forms cannot be enclosed and heated without spending money. Our experience has been that mass concrete placed in winter costs approximately 8 percent more than similar concrete placed in summer. This percentage includes the cost of the installation and operation of the boiler plant, steam lines, heating of aggregate and water, and the protection and heating of forms and buildings.

In conclusion, it should be pointed out that any job, large or small, should be planned so that the concrete work can be done as far as possible in temperatures above freezing. Too often an owner or manager decides that a job must start immediately, totally disregarding the time of year, with the result that much of the work that should have been done in summer is done instead in winter. The cost of such work is bound to be increased. Work that can be completed in less than a year should be started as early as possible in the spring, especially if it is a concrete job, so that it can be finished before cold weather. Longer jobs, where there is no possibility of avoiding winter work, should be planned to have such operations as excavation and cofferdams done in winter since they do not cost a great deal more then than in summer. As far as possible and practicable, the Hydro-Electric Power Commission of Ontario adheres to this policy.

(This article is based on a paper presented by the authors before the joint session of the Construction and Power Divisions at the EIC-ASCE Meeting in Toronto.)

Interstate Commission Tackles Pollution Problem in Ohio River Valley

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NOWHERE has community growth and industrial expansion brought a greater foulness to water courses than in the Ohio River Valley. Nowhere does the continued prosperity and growth of a region depend more on the use and re-use of water resources. For example, industrial demands on the Mahoning River alone are such that in periods of low flow the water would be re-used some ten times, each time, of course, with progressive reduction in quality.

Situations such as this, and their portent for the future, led to the creation of the Ohio River Valley Water Sanitation Commission in July 1948. It is a regional agency, representing eight states, dedicated to the task of conserving water resources by pollution control.

The Ohio River drainage basin (Fig. 1) encompasses an area in which there are thousands of industrial establishments, some of them the largest of their kind in the world. This thickly populated territory is the industrial heart of the United States, and water is a basic resource.

Despite the installation of sewage treatment facilities that now serve one-third of the population, the streams of the basin are burdened with pollution. Into them pour the untreated wastes from 8,500,000 people; and from industries come pollutional wastes equivalent to another 10,000,000 people. In addition, there is the drainage from both active and abandoned coal mines, estimated to contain as much as 2,500,000 tons of acid each year.

On the one hand the streams are required to supply a basic necessity—water without which human and industrial life cannot exist. On the other hand these waterways must serve to dilute and carry away the wastes from communities and industries because there is no other place into which these wastes can drain. Is there any way of reconciling these conflicting uses? As an engineering problem the technical means are not too difficult, although they are expensive. Rivers have miraculous powers of self-purification, provided they are not overloaded with wastes. From a scientific standpoint, therefore, all that is necessary is to treat or otherwise reduce the pollution burden to the point below which the rivers can handle the remaining load by natural purification processes.

A Philosophy Put Into Practice

Who is going to make and enforce decisions for the treatment of these wastes to the point where they no longer constitute a menace to public health or welfare? Many philosophies reflecting social, economic and legal viewpoints must be weighed in reaching a conclusion. Perhaps the most profound summation of these viewpoints, certainly the simplest and most practical one, appeared in a 1931 decision of the Supreme Court of the United States regarding the use of rivers. This decision stated:

> "A river is more than an amenity; it is a treasure. It offers a necessity of life that must be rationed among those who have power over it."

Many years before these words were written, this same thought motivated some men of vision in the Ohio River Valley. These few recognized that unless the use of the river for waste disposal was rationed, this "necessity of life" could be destroyed. As far back as 1908 the problem was discussed by representatives of the states in the valley.

Among other things it was not clear who should have the power to apportion these uses. The Ohio River is an interstate stream, and pollution does not begin and end at the state boundaries. The wastes pouring into the headwaters of the river in the Commonwealth of Pennsylvania, for example, may exert a damaging influence for considerable distances downstream, where the waters touch the shores of Ohio and West Virginia. And the untreated wastes from sources in these states in turn may effect the well-being of citizens further downstream in Kentucky, Indiana and Illinois.

It was apparent that there were only two ways to cope with this interstate pollution problem—either through federal control or by agreement among the states themselves.

The states in the Ohio River Valley decided that an interstate compact offered the most desirable means of getting results. After nearly fifteen years of negotiation a compact was executed on June 30, 1948, pledging eight states in the valley to join in the common effort.

Each of the signatory states pledged to each other faithful cooperation in the control of future pollution and the abatement of existing pollution. To carry out this action a board of commissioners was created. On this board each of the eight states (Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia and West Virginia) is represented by three commissioners appointed by the governor of the state. In addition, there are three federal commissioners, appointed by the President of the United States, representing the Surgeon-General of the U.S. Public Health Service, the U.S. Army Engineers, and the Fish and Wildlife Division of the Department of the Interior. The role of the commissioners is to determine policy for carrying out the provisions of the compact.

Commission May Order Abatement

Most importantly, under the terms of the compact the Commission is empowered to issue orders for abatement which are binding on any municipality, corporation, person or other entity discharging sewage or industrial waste into the Ohio River or its tributaries.

To insure judicious exercise of this grant of power, the compact provides that the issuance of an order requires approval of a majority of the commissioners from a majority of the signatory states, together with the assent of the majority of the commissioners from the state in which the order is to be issued. In terms of numbers, this means that 2 commissioners from each of 5 states, or a total of 10, must agree, and in addition there must be a favorable

vote from 2 of the 3 commissioners in the state affected.

Funds for operating the Commission are appropriated by the signatory states in accordance with a formula based on the proportionate population and area of the state within the drainage basin. The minimum contribution, 1.15 per cent, comes from New York State, only a small part of which is within the drainage basin. The largest contribution comes from Ohio, amounting to 22.6 per cent. At present the yearly budget of the Commission is $100,000.

What the Commission Is Doing

Although only recently organized and staffed, the Commission feels that it has made substantial progress toward the realization of its objectives. The main steps so far taken are the following:

1. One of its first actions was to establish a water quality objective in the Cincinnati Pool, a 22-mile stretch of the Ohio River. Already contracts for a sewage-treatment plant in Cincinnati have been let, and similar action is soon to be taken by the Kentucky cities involved.

2. Investigations have been made relative to sewage treatment requirements at Pittsburgh and other major cities on the Ohio River. In a river 981 miles in length there are many variables, and no single standard for treatment is applicable.

3. The Commission has taken action with two of the signatory states to prevent the discharge of new pollution in the form of hardness-producing wastes from proposed industrial plants.

4. On the Wabash River, a major interstate tributary, the Commission has just completed an analysis of pollution loads in a 100-mile stretch of the stream. With this evidence, the states of Indiana and Illinois will be able to strengthen any legal action that may be needed to insure installation of treatment facilities.

5. Although the Commission does not propose to engage in research it did inspire and has undertaken the direction of a cooperative project with private-enterprise interests to determine if a practical method for the complete elimination of phenols can be developed. Pilot-plant work is now under way.

6. Of major importance as a step toward unification of effort by the eight states was the issuance of notices to 1,159 municipalities and 1,422 industries regarding terms of compliance with compact provisions.

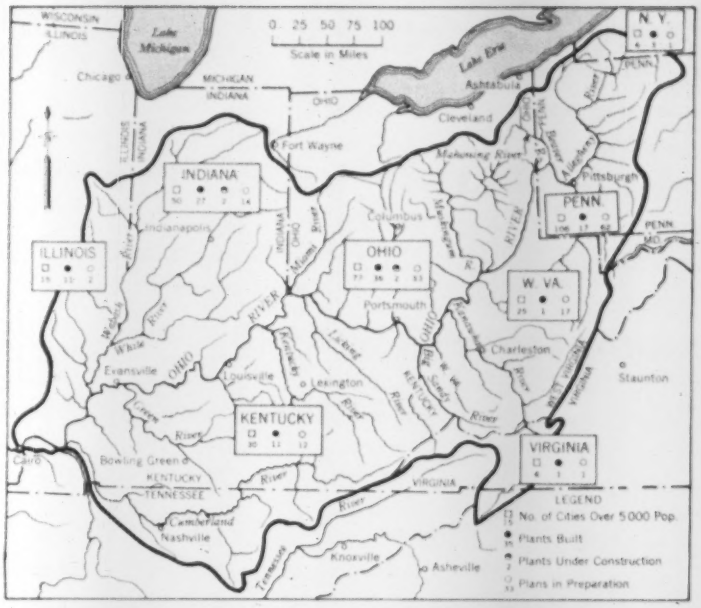

FIG. 1. POLLUTION CONTROL PROGRAM for Ohio River Basin includes construction of numerous sewage treatment plants in cities of 5,000 or more population. Program is conducted by Ohio River Valley Water Sanitation Commission, created in 1948 by compact among eight states—Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia.

As a follow-up, quarterly progress reports are being obtained from municipalities of over 5,000 population. Meantime, management representatives of related industries are being invited to conferences with the Commission.

7. The Commission has met with the steel industry, chemical-brine industries, the distillery group, oil producers and the electro-plating industry. The result has been the establishment of some permanent industry action committees with whom the Commission will work in promoting joint research, development of standards and installation of treatment plants.

8. In addition to this management-level approach to problems of industrial waste reduction, the Commission in conjunction with the state regulatory agencies has inaugurated a system of reports from individual industrial establishments. These check reports are designed to provide information on volumes and characteristics of wastes as well as progress in their reduction.

9. Many interstate pipelines cross the area. Companies operating these facilities have assisted the Commission in compiling a recommended set of procedures, the adoption of which will minimize the possibility of oil contamination of streams when a pipeline break occurs.

10. The Commission's staff aided in the formulation of legislation for Kentucky, a signatory state, whereby more effective control of pollution could be exercised in accordance with compact requirements. On June 20 the provisions of this new law went into effect.

United Action on Common Problem

No one is under the delusion that the organization of the Commission created a magic wand, the waving of which will bring an end to pollution problems. However, formation of the Commission for the first time provides the means for integrating the efforts of state regulatory agencies, the federal government, the industries and the people of the Ohio River Valley to solve a common problem by united action.

Some important questions have not been resolved. Recently, for example, the Supreme Court of Appeals of West Virginia ruled in a 3 to 2 decision that ratification of the compact

by the state legislature was unconstitutional. The compact commissioners from West Virginia have petitioned the Supreme Court of the United States to review this decision. The primary question on which the Court is asked to rule, and which is of significance to all other interstate compact agreements, is: Can the power of a state of the Union to enter into compacts with other states be limited or restricted by the provisions of its own constitution?

There are those who look upon what is being attempted in the Ohio River Valley as an experiment in American government. Some see it as a vast educational campaign to awaken social responsibilities. And others conceive of it as a problem of economic balances and of engineering skills. It is, in fact, all of these things.

(This article is based on the paper presented by Mr. Cleary before the Sanitary Engineering Division at the joint EIC-ASCE meeting in Toronto, Canada.)

Comprehensive Plant Survey Simplifies Problem of Industrial Waste Disposal

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THE FIRST STEP in a program of industrial waste disposal, either for a single industry or for all the waste producing industries in a community, is to make a complete survey of the plant or plants producing the wastes, whether the investigation is conducted for the industry on its own behalf or for a governmental agency. Information as comprehensive as possible should be secured as to total volume, composition and concentration, and also general characteristics of the flow as regards rates and total period of discharge, and whether the discharge is intermittent or continuous throughout the day, week or year. To accomplish these ends, it is essential that the survey be continued over a sufficient length of time to enable a proper evaluation of all the factors involved. The survey may be accomplished in a short time or may take months, depending on the size, type and age of the plant, and the volume, character and intensity of the waste discharge.

It is now generally recognized that no industrial wastes investigation should be regarded as a punitive expedition. Most manufacturers are good citizens and vitally interested in maintaining cordial relations with the public. It is only within relatively recent years that attention has been focused on maintaining public waters free from undue pollution and the resulting hazards to health and welfare. The progress made in correcting pollution has been gratifying and has been made possible through the cooperation of all concerned with the problem.

Location Influences Disposal Methods

The location of the plant has some bearing on the problem of the disposal of its wastes. If it is in an isolated area, controlled disposal may be required to prevent pollution to recreational waters or to a livestock or public water supply. If it is near a built-up community the matters of odors and appearance must also be taken into consideration.

If no public sewers are available, possibilities for the disposal of the wastes are:

1. Discharge direct to a watercourse without treatment.
2. Discharge to subterranean storage and dissemination.
3. Partial treatment and discharge to a watercourse. This may involve varying degrees of partial treatment or merely storage with a regulated uniform outflow.
4. Complete treatment and discharge to a watercourse.

If the manufacturing concern is located in a community that has a public sewerage system and sewage treatment plant, the proper disposal of the industrial wastes will first of all depend upon the relative contribution of the industry as compared with that of the resident population. In this case the possibilities for the disposal of plant wastes are:

1. Discharge to the public sewers with no treatment.
2. Discharge to the public sewers after
   - (*a*) Regulated uniform discharge and no other treatment
   - (*b*) Partial treatment to a prescribed degree
   - (*c*) Complete treatment
3. No connection with the public sewer system, and treatment as required for an isolated plant.

In starting the survey, an agreement should be made with the top management, and all communications directed to it. It is essential that the investigator establish proper relations with the management by showing credentials and being put in touch with the personnel best able to assist in securing the information sought.

Note Seasonal or Other Fluctuations

The number of employees and any seasonal or other fluctuations in personnel or plant operation are helpful factors in over-all evaluation. Also, the period of plant operation as to hours per day and days per week and year should be recorded, with any peak periods in production.

All operations producing wastes must be carefully described. Some industries manufacture a single product, others a diversity. The investigator should not attempt to pry unduly into trade secrets, whether he is working for the industry direct or for some outside agency. A general knowledge of the processes involved will usually serve.

Wastes, in general, may be classified as solids, such as chips and fleshings; semi-solid, as slurries and sludges; and liquid, those that contain solids both in suspension and in solution. In general, the greatest concern is with the liquid wastes, al-

though the others must not be overlooked. Solid and semi-solid wastes should not be discharged into a public sewer in any case, and wherever possible should be handled for disposal directly from the point of production.

Since the liquid wastes are usually of greatest concern, the water consumption of the plant should be carefully studied, not only as to total volume, but also as allocated to various uses, such as domestic, cooling, boiler, general cleaning and processes. Under domestic use would fall drinking fountains, toilets, wash racks and cafeteria; cooling water would include water for condensers, air conditioning, transformer cooling, compressors and hydraulic elevators; and process waters are those used in manufacturing the products of the industry.

Flow Sheet of Water Use Needed

A flow sheet of water usage is necessary, particularly in a large industry, so that total volumes can be established and balances made. Note should be made of the source or sources of the water supply. It is surprising how few industries develop a water consumption flow sheet. Attention to this detail often results in detecting unnecessary wastage and in effecting savings that not only conserve water but also reduce wastes.

The kind and quantity of raw materials used, balanced against the amount of the manufactured product, often gives information concerning the wastes better than analyses alone. For example, where sulfuric acid is used solely for the pickling of iron or steel, it can be safely concluded that all of this acid is discharged to waste, either as free acid or as iron sulfate. Again, in the scouring of wool, the percentage loss is always definitely known. Where chemical processes are involved, the record of the chemicals used can furnish checks on the results found from analyses.

Liquid wastes can be divided into two general classifications—clean and foul. Most of the clean wastes may be called cooling waters, while the foul wastes include domestic sewage and process water.

Importance of Plant Sewer System

This brings up a most important part of the plant survey—the sewer system. In many older plants, the sewer system is a nightmare. New lines are laid when needed, the principal objective being to find an outlet without much attention to the effect on other lines. Domestic sewage, cooling water, process wastes and roof water are often found in the same pipes, a situation which greatly complicates the problem of treatment. On the other hand, in many of the newer installations, domestic sewage is carried in separate lines, storm water and cooling water are confined to drains for that use alone, and process waters have separate conduits. Where this condition prevails, the problem of industrial wastes treatment can be approached with more assurance. In general, where there is a problem of treating industrial wastes, domestic sewage and process waters should not be mixed.

Assuming that the process wastes are properly segregated, it is important to know not only the volume and characteristics of those wastes, but also whether they are discharged intermittently or continuously and are subject to wide fluctuations. If the wastes are to be treated and disposed of by industry itself or through a public sewer system, the manner of discharge is important.

Noxious and Toxic Wastes Catalogued

More and more municipalities are enforcing ordinances regulating admission to the public sewer system. Slugs of concentrated waste are rightfully regarded with suspicion and are a just focus for control. Oils, strong acids, alkalis and toxic materials such as cyanides, copper and zinc salts, and phenols are often excluded entirely or limited to specified quantities, particularly where sewage treatment processes are involved. All these materials and others having any significance in any discharge of wastes must be covered in the survey, and proper evaluation made as to their effects either singly or in combination with other wastes.

The matter of gases, malodorous or toxic, occurring locally or after discharge by interaction with other wastes, must be given due consideration when planning for disposal. Extremely dominant and strong wastes, when in relatively small volume, can often be segregated and disposed of separately with advantage.

The information gained and conclusions reached from the physical data should be confirmed by careful sampling, chemical analyses and flow measurements. With a reliable flow sheet in hand, the wastes from different sources, if several are produced, can be measured and sampled, the constituents computed from analyses, and the effect on the wastes as a whole evaluated. For example, where such data are available, acids and alkalis can be discharged in such sequence as to effect neutralization in whole or in part, and thus save treatment at the final point of outlet.

Analyses of all component wastes singly, should, when totaled, give reasonable check with the analyses of the composite of all wastes combined, particularly where there are no radical interactions between wastes from different processes. In surveys made a few years ago in two cities where plant surveys were made along with sampling and analyses, it was gratifying to note in one case that the suspended solids in the mixed sewage and wastes as synthesized from analyses of samples from individual sewers, checked very closely with the analyses of the total flow as made by others at the city's sewage treatment plant. In the other city a breakdown of individual major industrial contributions combined with the domestic sewage, when totaled, agreed very closely with the composite analyses of the mixed sewage and wastes at a large main outlet. This particular investigation was conducted over a two-year period.

An important phase of the industrial plant survey is the training of technical personnel within its own organization to secure data and interpret findings. Industry can do much in its own behalf by maintaining a continuous plant survey to include all significant waste factors. This may well be regarded as a routine step in manufacture. Some industries are now following this procedure with gratifying and even profitable results. Adequate preparation is very helpful when the call to clean up is heard.

Good Industrial Housekeeping Needed

Industrial management is primarily interested in production at a profit. The wastes from manufacturing processes are a necessary evil and, in recent years particularly, have become a source of concern. If, by a careful survey of all elements in the plant contributing wastes, and with resulting savings by "inside treatment" involving better housekeeping and improved procedures, these wastes can be reduced in volume and lessened in concentration, then the problem of final methods of disposal will be simplified. Also, the savings in material previously lost may result in returns which will lighten the expense for preparing the unavoidable and unredeemable part of the wastes for acceptable discharge, to the end that all the interests concerned may be content.

(This article is based on the paper presented by Mr. Jones before the Sanitary Engineering Division at the EIC-ASCE joint meeting in Toronto, Canada.)

Canada's First Subway Features Easy Transfer from Surface Transportation

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REALIZING THAT 75 percent of the passenger traffic on Toronto's new subway, Canada's first, will come from surface transit systems, engineers have designed the interchange points so that the transfers can be made with a minimum of confusion. The subway will replace worn-out tracks and equipment of a surface system along Yonge Street, the only through street serving the community of North Toronto now grown to 100,000 population.

The Toronto Transportation Commission now operates about 1,000 street cars, 500 buses, 100 trolley coaches and carries over 300,000,000 passengers a year. Yonge Street is the main artery of this system of surface transportation, and after 29 years of operation the tracks and equipment must be replaced. To replace the old surface system with new surface tracks and cars would cost over $12,000,000 and would perpetuate for 25 years present traffic conditions, which are intolerable. Speeds downtown are as low as 6 miles per hour. The subway cost was originally estimated at about $30,000,000 exclusive of rolling stock, but this estimate will of course be exceeded because of rising costs of labor and materials.

In 1943, the Commission retained the services of Norman D. Wilson, Toronto consultant on transportation planning, and set up a small staff to prepare a plan of rapid transit for the city. In 1944, the Commission retained the services of DeLeuw, Cather & Co., of Chicago, to advise on the design of structures. A Rapid Transit Department was created and general plans for the Yonge and Queen Street subways were completed that year. Early in 1945, with preliminary planning completed, the Commission authorized the preparation of contract drawings and documents for the Yonge Street Subway.

The early and determined decision to plan for the subway, made in 1945, is probably the most outstanding feature of the entire project as it gave both engineering and operating officials an unusual opportunity to review and criticize designs before their incorporation in contract plans. The decision of the Commission was approved by the City of Toronto in January 1946, when it voted 10 to 1 in favor of the rapid transit proposal.

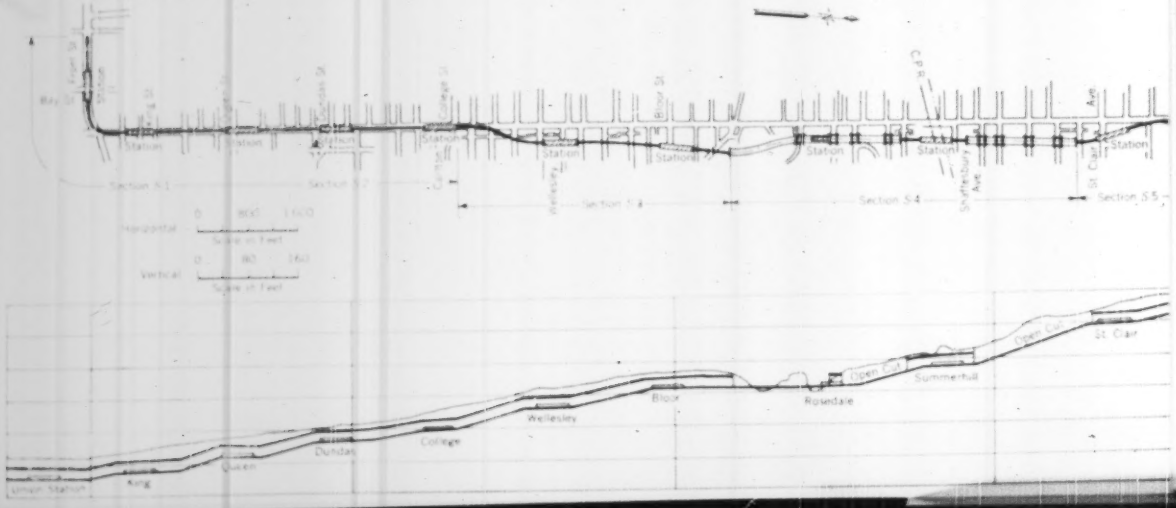
Here was an unusual opportunity. Since the entire system—rolling stock, track, signals, and auxiliary equipment—would be new, the structure was not required to conform with any existing structures or operations. Design practices in other subways, both in North America and in Europe were studied, and the best of modern materials and construction methods were adopted. Our investigations also resulted in the adoption of some practices new to subway construction.

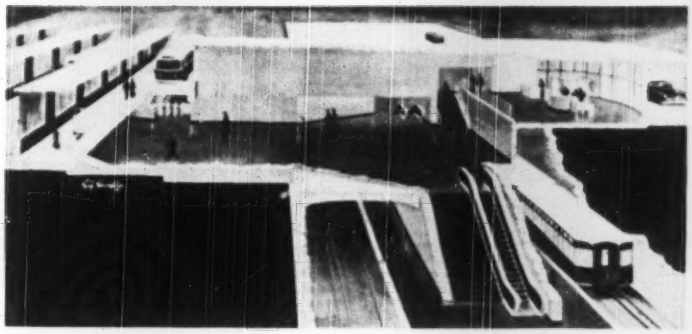
Northern Section on Private Right-of-Way

The Yonge Street Subway starts on Front Street at the Union Station, Fig. 1, about 1,200 ft west of Yonge Street. From here it runs east to Yonge Street, then north under this street about 5,800 ft to College Street, about the northern limit of the downtown area. North of College Street the subway swings east about 150 ft to a private right-of-way which it follows to the terminal at Eglinton Avenue. This private right-of-way was adopted because it provided better grades, savings estimated at $6,000,000, and better transfer arrangements at crosstown lines. This last benefit is extremely important as about 75 percent of the subway passengers will transfer to or from surface vehicles.

Because of this very heavy transfer movement, it was desirable to locate the subway tracks at the high-

FIG. 1. YONGE STREET SUBWAY has generally straight alignment with curves spiraled according to AREA standards. Only short-radius curve, 400 ft, is at south end where subway turns off Front Street. Grades are kept as near surface as possible to facilitate transfer between surface systems at stations. It is estimated that 75 percent of subway passengers will transfer from surface vehicles. Maximum grade is set at 3.5 percent.





EGLINTON STATION at north terminal of subway has center platform permitting reversing of trains over cross-over switches. Use of transfer slips or tokens is eliminated by having surface system unload passengers in station. Escalators, used in all mezzanine stations, facilitate passenger flow

est possible elevation to make the transfer to surface vehicles as short and convenient as possible. To protect utilities, however, a minimum cover of 8 ft was provided wherever utilities were encountered.

The alignment is generally straight with easy curves, all spiraled according to standard AREA practice. There is one short-radius curve, of 400 ft, which occurs at Front and Yonge Streets. Vertical curves are generally easy and the maximum grade is 3.5 percent.

Reinforced Concrete Box Section Adopted

For the subway structure a reinforced concrete box section was adopted (Fig. 2). The typical subway section between stations has an over-all depth of 17 ft 8 in., and an inside width of 13 ft 6 in. for each track with a clearance over the top of rail of 13 ft. Openings 5 ft wide by 7 ft high are provided in the center wall at intervals of 15 ft to serve as refuge bays for workmen and relieve air pressure caused by the movement of trains. A continuous walkway 2 ft wide is provided along the outside wall of the structure just above the track level.

At station sections, the subway structure widens to 52 ft 4 in.; the height is increased to 18 ft 3 in.; and the inside width for each track becomes 23 ft 5 in. This clear space permits platforms 11 ft 10 in. wide without a single column to interfere with the movement of passengers. The center-line support at stations is provided by steel columns at about 13-ft centers thus opening up the station structure to permit full view of its entire width. Station platforms will be 500 ft long to provide for the ultimate operation of trains composed of ten 48-ft cars. Platforms at all stations except terminals are located at the side of the station.

The open-cut sections of the subway system have been designed with 2:1 side slopes. The typical section will have a width of 44 ft at the bottom of the slope and an over-all right-of-way width of 120 ft. To carry cross streets over the open cut, a fixed-frame reinforced concrete bridge has been designed with a typical span of 48 ft 4 in. and a minimum vertical clearance above the top of rail of 13 ft.

There will be twelve stations on the Yonge Street subway, located at all main intersections. Plans for all stations with mezzanines include escalators as well as stairs for the convenience of passengers transferring between the Yonge Street and the proposed Queen Street subway which intersect at the Queen Street station. The Queen Street subway will pass under the Yonge Street subway at this point.

To make sure that the work could be started on schedule, the Commission placed a firm order for the 8,000 tons of steel required for falsework. The specifications required the contractor to accept delivery of the quantity of steel involved, but he was able to make size changes for most of the falsework. This procedure permitted work to begin immediately after the contract was awarded, and avoided the delay that would probably have occurred if the contractor had placed his order with the mill after receiving the contract.

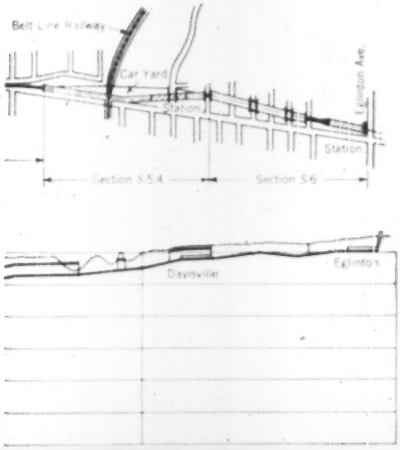
Traffic Diverted to Facilitate Progress

To minimize traffic interruptions and to facilitate progress on the subway, the Commission developed a system of traffic diversions that gave the contractor uninterrupted use of a section of the street for a stated time. These plans, after being checked by the police, fire and other civic officials, were incorporated in the contract documents. In accordance with these plans, which have been modified by mutual agreement, street cars and vehicular traffic have been diverted over other routes during the period required for the installation of the decking. The work of removing and reinstalling track and overhead for these diversions is done by Commission forces.

Maintenance of public utilities during subway construction is a major item. In this case the problem was simplified by the good offices and by the records of Toronto's Public Utilities Coordinating Committee. This committee, made up of representatives of the various utility companies, had been established to arrange and coordinate the occupancy of the street below pavement level. It maintains a staff and prepares plans showing the existing location of the various utilities, and it and its records have been a tremendous help in planning the subway.

Agreements made with the various utility companies basically provide that the Commission will pay the value of plant destroyed based on replacement cost less depreciation, and will also pay for maintenance during construction. At this time the utility company can build such new plant as it desires. Under these agreements, and in the hands of a capable contractor, the work has progressed with surprisingly few consumer complaints.

Bell Telphone cables during the time of handling are put under gas pressure. If a cable sheath is damaged the gas pressure not only keeps water from reaching the cable but the loss of pressure gives an immediate indication of trouble. This procedure prevented four cases of serious



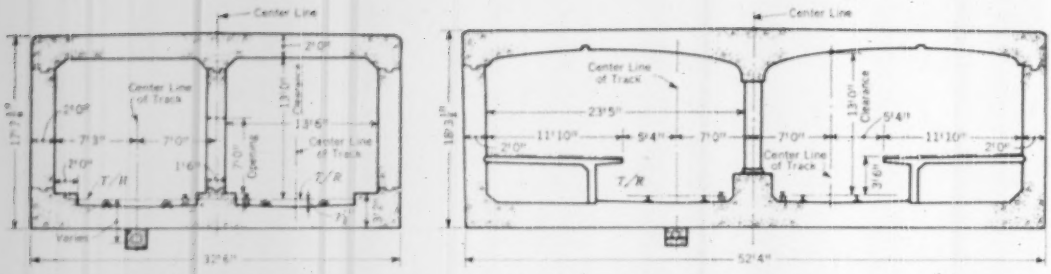


FIG. 2. SUBWAY SECTION provides 13-ft clearance above top of rail. Openings 5 by 7 ft in center wall provide refuge for workmen and serve to relieve air pressure caused by movement of trains. Section at stations (at right) widens to 52 ft 4 in. providing 11-ft 10-in. unobstructed platforms on each side of station. Stations are 500 ft long, accommodating ten 48-ft cars. Center supports are steel columns so placed as to permit full view of entire station.

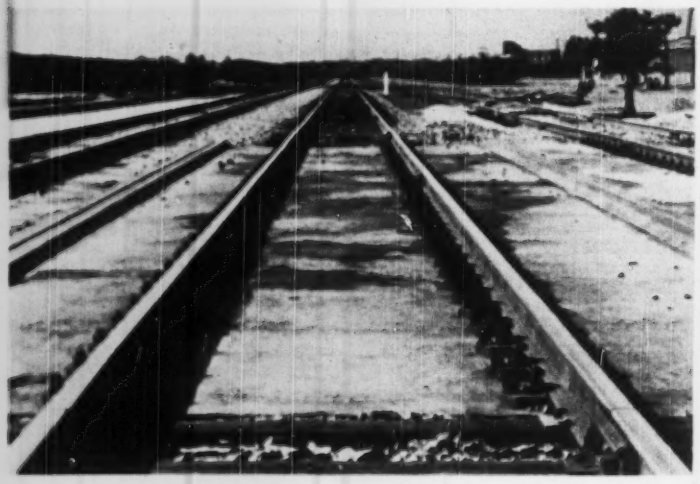
trouble at one intersection during the decking operations going on over one week end.

To avoid possible explosions, all gas mains are removed from the cut. Common practice is to build temporary mains above ground permitting existing mains to be cut off and purged. With the assistance of the Consumers' Gas Company a plan was developed by which mains were placed below ground in streets parallel to the subway and small temporary feeders were installed below the sidewalk, adjacent to the buildings. This plan, which was included in an agreement made with the gas company, has worked out satisfactorily to both parties, with very limited interruptions to service. The interests of the utility companies and the City Works Department are protected by their inspectors on the job.

Special Track Design Saves $500,000

Original track design of the Yonge Street subway provided for half ties set in concrete, a common practice in many subways on this continent. However, after carefully considering various types of subway track construction, a modification of the type of track used by the Canadian National Railways on bridges was finally adopted, except under special work and in the open cut, where it will be necessary to use wooden ties and ballast.

This type of track, which has been used on bridge decks for as long as fifteen years, utilizes a malleable iron plate bolted directly to the concrete deck of the bridge. A cushion for the rail is provided by a rubber pad under the plate. Insulation of this track for signaling purposes is obtained by using fiber bushings around the hold-down bolts and fiber washers under the springs. The bolt holes in the plate are slotted to allow sufficient lateral movement to obtain accurate gaging of track, and after the track has been set to gage the bolt holes are filled with lead. Vertical control is obtained by the use of shims underneath the plate. By adopting this track design, the depth of the structure was reduced by 12 in. with a resulting saving of well over $500,000.



SECTION OF TRACK used by Canadian National Railways is very similar to design adopted for subway. Track rests on malleable iron plate bolted directly to concrete. Rail is cushioned by rubber pad beneath plate. Insulation for signaling purposes is obtained by using fiber bushings around holddown bolts, and fiber washers under springs.

Ventilation of the Yonge Street subway follows normal practice, using the piston action of the trains to force air in and out of the subway through ventilator shafts. These shafts are located at both ends of each station and midway between stations on both sides of the subway. Fans and louvers will be installed to control the movement of air and to supply fresh air when trains are not operating.

Fluorescent lighting will be used throughout the system. Emergency lights will be installed, which in the event of a power failure will be automatically and instantaneously fed from storage batteries.

Supervisory Control System Installed

A supervisory control system of modern design will be installed which will permit all breakers supplying traction power to the subway to be controlled by a centrally located load dispatcher. This system will also incorporate a chain of emergency alarm boxes spaced 500 to 800 ft apart throughout the subway. If an emergency occurs which makes it necessary for passengers to leave the train, activating any one of these boxes will automatically cut off the

power to the third rail in that section and send in an alarm to the load dispatcher. A telephone will be located adjacent to each alarm box for communicating details of the emergency. The control of ventilating fans and the indications of failure of any pump or auxiliary power supply will also be obtained through the supervisory control system.

Automatic Three-Color Light Signals Used

Automatic wayside light signals of the three-color type will protect the operation of the trains in the subway. A train-stop mechanism will be associated with each signal to enforce obedience to the red signal. Speed controls on severe down grades will automatically enforce speed regulations.

All yard approach signals will be semi-automatic, that is, occupancy of the track will be automatically indicated but switch movements will be manually controlled. The automatic interlocking feature associated with each switch and signal will prohibit conflicting train movements.

Normally the interlocking switches at both north and south terminals will function automatically, but it will be possible to operate them manually if warranted.

Proposed Fluorescent Lighting Intensities for Yonge Street Subway

Location	Foot-Candles
Mezzanine or control areas	7.5 to 12.0
Stairways and escalators	10.0 to 12.0
Loading platforms	7.5 to 12.0
Train tubes	1.0

No duct bench is provided in the Yonge Street subway. All cables will be racked in the wall of the structure where they can be easily inspected and maintained. This is an adoption of European practice which results in considerable saving over the usual American practice of providing a bank of ducts on one or both sides of the subway.

Among the most interesting features of the subway are the unusual transfer facilities at the stations north of College Street. These stations, which are on private right-of-way, are designed as attractive above-ground buildings with special attention to facilities for transferring passengers. At these stations passengers will move between surface vehicles and subway platforms without having to pick up or present transfers.

The subway was divided into seven separate sections to facilitate planning and awarding of contracts. Sections 1 and 2 were awarded in 1949 to Pitts, Johnson, Drake & Perini. Sections 3, 4 and 5 were awarded in 1950 to Rayner Construction Ltd. Work will start on Sections 5A and 6 in 1951. All work is scheduled for completion in four years, which means that the Toronto Transportation Commission will be operating Canada's first subway about Christmas Day, 1953.

(This article is based on the paper presented by Mr. Paterson before the Construction Division at the EIC-ASCE joint meeting in Toronto, Canada)

Owner-Contractor Cooperation Cuts Toronto Subway Construction Costs

CHARLES B. MOLINEAUX, M. ASCE
Chief Engineer, The Arthur A. Johnson Corp., New York, N.Y.

SAVINGS IN construction costs on Toronto's new subway have been realized in several ways. Permission secured for the contractor to bring some of his construction vehicles from the United States saved the Toronto Transportation Commission up 200 percent on certain items. Further economies were realized when the Commission closed the streets during decking operations, to provide ample room for construction activities. The construction methods being used are those that have been tried and proved in the construction of subways in New York, Philadelphia, and other American cities. All was not milk and honey however. Since this is Canada's first subway there was a shortage of labor skilled in the special construction techniques required. Nor could subcontractors in the various subway specialties be found.

The subway structure is mostly in clay over shale rock, with about one-third of the structure on rock and the rest on clay. The bracing of the cut and support of the temporary street surface, or decking, is being done by the soldier-pile method. This method consists of driving steel I-beams along the excavation line to a depth of from 6 to 8 ft below subgrade, depending on soil conditions, and bracing across the top with steel I-beams. As the excavation proceeds, wood sheeting is placed horizontally between the flanges of the I-beams instead of being driven down with the excavation; that is, each sheeting plank remains in the position where it was originally placed. To prevent movement of the ground, it is usually necessary to pack sand behind the sheeting, which is done through openings between the planks. In clay soils the sheeting is wedged back from the flanges of the I-beams. It is usually necessary, in subway work, to excavate pits or a trench in advance of the driving of the soldier beams to disclose the location of subsurface structures so that damage to them can be prevented.

Street decking is carried on steel beams placed across the cut, which are in turn supported by a continuous cap on the soldier piles. The cap not only provides decking support but also braces the top of the soldier piles that are not directly under the cross beams. In this particular excavation the soldier piles are on 6-ft centers and the decking beams on 12-ft centers, which means that alternate soldier piles are braced by the cap.

Occasionally, because of the presence of a subsurface structure that cannot be moved, there is a variation in the spacing of soldier piles which of course does not greatly affect the work.

Because of the adoption of a reinforced concrete design for the Yonge Street Subway, it was felt that intermediate supports would be undesirable. Where the width of the cut made it impractical to use steel beams, a truss was designed for the decking support. After a number of these trusses had been installed it was found that the interference of subsurface structures and the very

greatly increased depth of excavation for decking made the truss system undesirable and a system of rigger braces was designed and used for the remainder of the work, except in cases where unusually long spans were encountered.

Some of the outstanding problems of construction are definitely related to the fact that the Yonge Street Subway is the first in Toronto as well as in Canada. The great public interest in the subway combined with the fact that the work is being done in the very heart of a large city makes it assume great importance in the minds of everyone. From the very beginning there has been no shortage whatever of sidewalk superintendents. Although this interest may mean good public relations for the Toronto Transportation Commission, there are definitely times when it is a handicap. A good circulation of traffic must be maintained, and for the convenience of the work it is often necessary to limit the width of available sidewalk. A large number of onlookers constricts a sidewalk that would otherwise be adequate, and makes necessary the building of a tight fence.

In a field new to an area, it seems that unfamiliarity gives rise to so much uncertainty on the part of construction organizations that they are very indifferent about getting the work, and the only competition that can be stirred up is among the smaller and less responsible companies. This was particularly true in the item of hauling. Under city ordinances the permissible load carried by an individual vehicle has definitely curtailed the development of hauling subcontractors and most of this work goes to contractors owning one or two trucks.

In the case of the Toronto Subway, when a subcontractor able to undertake the entire job was found and given the work, these small contractors were so concerned about continuing what was to them an advantageous situation that they did everything possible to enlist the aid of city authorities. For a time they succeeded in preventing the subcontractor from starting his work by preventing the issuance of city cartage licenses. The press even took an active interest in the matter and the prospective subcontractor as well as certain men in public life were put in such a poor light that it became almost a matter of civic morality to prevent this work from being done in the way that it usually is done on subway construction in the United States.

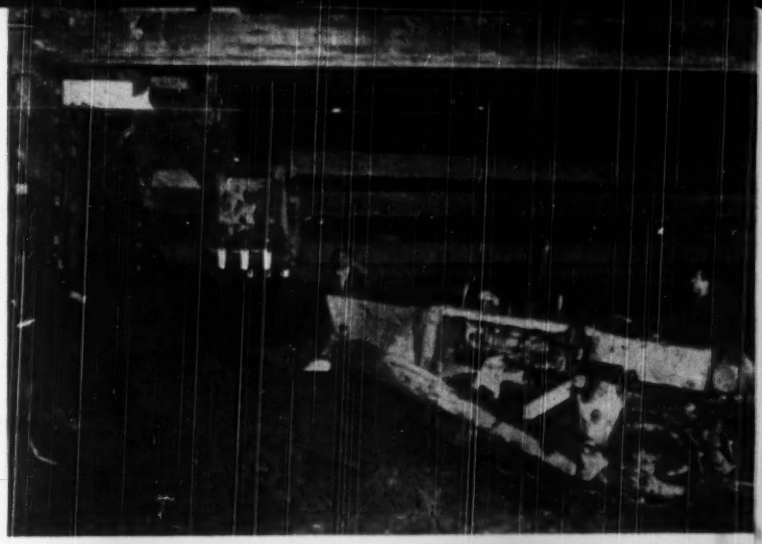
TOP-LIFT EXCAVATION closes street intersection to street cars over week-end, and to vehicular traffic for only one week. Closing streets to traffic during decking operations, one of contract provisions, greatly facilitates construction activity, and proves real economy to owners.

Street Closed During Decking

An outstanding feature of the project was the decision to discontinue street-car operation and to close the street to vehicular traffic in the areas being decked in order to give the contractor ample work room. This provision of the contract has proved very beneficial to construction operations and is a real economy for the owner.

There is a reservation in the contract forbidding work above the street surface during the month of December in order to avoid interference with the shopping on this important merchandising street. This gives rise to a problem in planning, because it involves setting limits on the amount of work to be undertaken in any particular season to insure that the street will be open on the agreed date. A strict schedule was maintained and the street was available two or three days before the official

SOLDIER PILES are driven along excavation line to depth of 6 to 8 ft below subgrade. Piles are braced across top by steel I-beams, which rest on continuous pile cap and also support decking. Trusses were originally designed to carry decking across particularly wide excavation, but proved impractical, and system of rigger braces was adopted instead.



BULLDOZER PILES bottom lift for removal by clamshell. Shortage of labor skilled in subway work necessitated extensive training programs. Miners, who were available in area, quickly assimilated special elements of subway work, and made excellent underpinners.

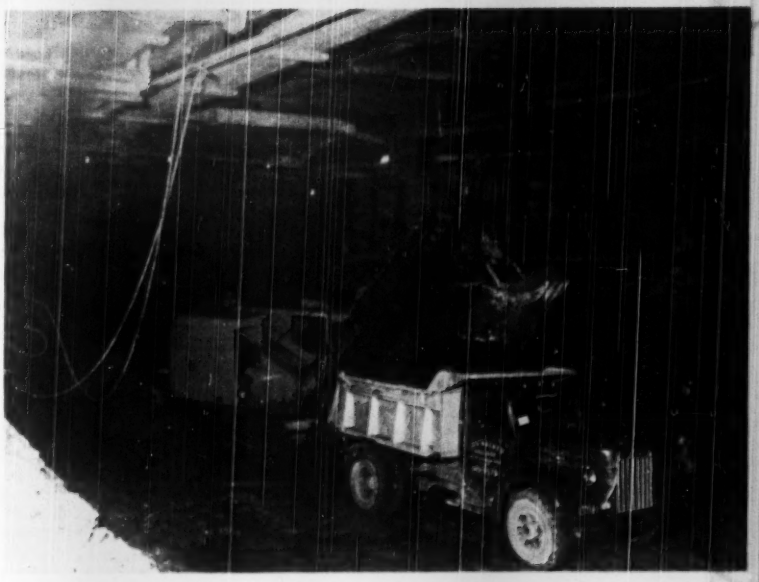
opening date in 1949. Similar plans will be made for each December that the work is in progress.

Although most people in the United States do not think of Canada as a foreign country, several minor border problems have arisen. At the time the work was started, currency values were pegged at par, and each Canadian dollar was worth almost exactly one American dollar. Although it was necessary to make provisions for fulfilling the requirements of the currency control board, there was no effect on prices, salaries of key employees or any other such matters. Before the work was under way a month, however, Canadian currency was revaluated at a discount of 10 percent against American currency. Although items purchased locally were not affected by this change, imported items began to reflect the difference. Imported key employees felt that they should get additional compensation to take care of some part of the currency discount because they had obligations outside of Canada that were on an American dollar basis. There is no provision for currency changes or any other escalation in the contract.

Importation of Equipment Permitted

Importation of construction plant and other major items was a factor obviously to be taken into consideration in the preparation of bids, but certain special problems arose. There is in existence a Canadian law that prohibits importing automotive equipment except in the year in which it is manufactured. This was originally interpreted to include truck cranes, always considered to be a large factor in subway construction, which were owned by the contractor and were available for this work. The difference between importing the machines and purchasing them locally in one instance was of the magnitude of 200 percent. After some discussion with the Canadian authorities, the contractor was permitted to import the machines.

Underpinning for this project involved nothing unusual except that a very much higher percentage of careful underpinning is required than normally because Yonge Street is unusually narrow for subway construction. There is a high percentage of old buildings with rubble foundations, many of which are laid up in lime mortar, and the clay overburden is not reliable for loads of more than 2 or 3 tons per sq ft.



POWER SHOVEL removes berm at side of excavation. Berms are left until shortly before pouring of invert to safeguard penetration of soldier piles.

It is usual in urban sections of the United States to find mechanics rather plentiful and common labor not too available or too willing. The reverse was found to be true in Toronto, where common labor is very willing and to date fairly plentiful. Skilled men and mechanics, however, seem to have permanent connections or are just not available in the area, and it has been quite a problem to find enough skilled men for the work. Of course no labor skilled in work that is peculiar to this type of construction was available and some time had to be spent in training timbermen, riggers, and operators. For underpinning, it was soon found that miners, who were available, very quickly assimilated the special phases of this work and became excellent underpinners.

(This article is based on the paper presented by Mr. Molineux before the Construction Division at the EIC-ASCE joint meeting in Toronto, Canada.)

Shoran—
Electronic Tool for Control Surveys and Mapping

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Dominion Geodesist, Geodetic Survey of Canada, Ottawa, Canada

GROUND STATION for shoran mapping control (above) has 50-ft antenna. Tent houses installation shown in lower photo. Shoran is expected to prove promising tool for rapid extension of mapping in vast areas in northern Canada with accuracy equivalent to that of secondary triangulation.

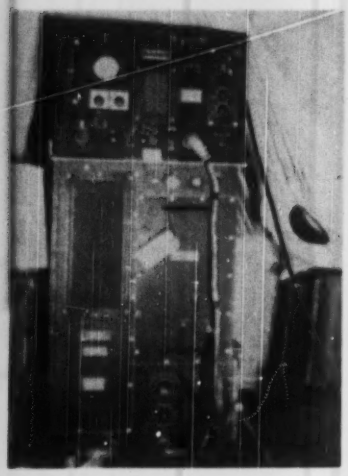


FIG. 1. INTERNAL LINE CROSSINGS on plane flight for shoran triangulation follow approximate right bisector of straight line between two ground stations. Readings of R and D are taken approximately every three seconds.

SHORAN (short-range aerial navigation) triangulation, an adaptation of radar electronic principles, seems likely to provide lengths equal in accuracy to those required for secondary triangulation. Shoran was developed in the United States during the war for use in precision bombing and the military results indicated that it could serve as a tool of far-reaching importance in extending accurate horizontal control quickly over large areas. It could also be used to span between areas where visual triangulation methods were impossible, such as for island groups either too far apart or lacking sufficient elevation to overcome the earth's curvature.

Early Development in Canada

The application of shoran to the provision of "control" and to mapping was initiated in Canada late in 1947 as a joint effort by the Royal Canadian Air Force, the National Research Council, the Army Survey Establishment and the Geodetic Survey. Early in October 1948, experimental work in equipment modification and the training of personnel had advanced to the stage where shoran measurement of lines joining accurately determined geodetic stations in Ontario and Quebec, situated 200 to 300 miles apart, could be undertaken. This was with a view to obtaining concrete data as to the degree of accuracy that might be expected in a practical survey. The flights were made at intervals throughout the winter over three lines forming a triangle. Close agreement was found between lengths obtained by shoran and those obtained by geodetic means.

In addition an experimental aerial survey was made of a small area east of Ottawa with the use of shoran equipment. During this test the aircraft was directed along the required flight lines by information derived from the shoran radar equipment. In addition the data from which the shoran determined positions of the aircraft, were recorded simultaneously with each vertical photograph. The adherence to the flight lines and the correlation between the shoran and the true positions of each plumb point displayed accuracies beyond expectation.

In conventional geodetic triangulation the angular points are 5 to 50 miles apart and adjacent stations are intervisible; the angles of the triangles are measured with precise theodolites; only a limited number of base lines are measured; and finally, after adjustment of the net, all other lengths are calculated. Shoran, conversely, is a distance measurement system and all lengths are measured; the shoran stations are from 100 to 350 miles apart, not intervisible; and finally, after adjustment, it is necessary to calculate the angles. In a sense the approach by shoran is the reverse of ordinary triangulation.

Obviously shoran can cover a much larger area than conventional triangulation, which makes it especially adapted to such a huge area as northern Canada. Obviously also, the density of the control is much less, but conventional triangulation or other survey methods based on the shoran net can rectify this disadvantage in sections of the country where more dense control is required.

Differences Between Shoran and Radar

In primary ground-based radar, the electronic apparatus is placed in a suitable location; an electromagnetic pulse is sent out, is reflected from a metal or other surface such as a ship

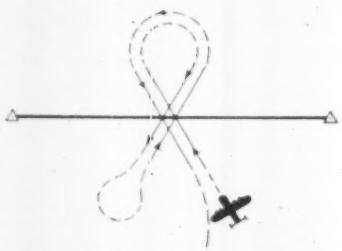


FIG. 2. FOUR LINE CROSSINGS by plane in form of figure eight constitute one fourth of program of shoran readings on each line.

or plane, back to the radar apparatus, and the *time* taken for the pulse to go to and come from the target is measured. This time is automatically converted in the apparatus into *distance* at the speed of light, assuming that the speed of the electromagnetic wave and that of light are equal.

In shoran the recording apparatus is contained in a plane which flies high over the area concerned. Pulses from the plane on different frequencies are received at two separate ground stations, and are automatically transmitted back to the plane. The distances from the plane to the two station locations are then recorded on dials in the shoran apparatus.

In practice, to secure the distance between two ground triangulation stations, the plane crosses above the midpoint of the line joining the stations nearly at right angles, as indicated in Fig. 1. When the plane starts its run the sum of the distances to the two ends of the line, termed R and D (rate and drift), is longer than the true distance (the minimum sum). As the plane approaches the line this sum decreases until the line is

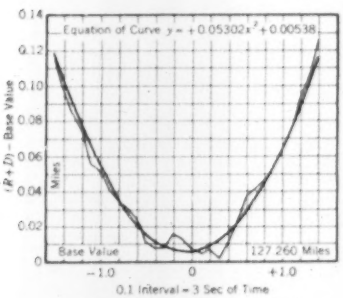


FIG. 3. PARABOLIC CURVE of $R + D$ readings shows change in recordings as plane approaches, crosses, and leaves straight line between two ground stations. Equation of best fit for this parabolic curve is calculated, and from it minimum $R + D$ is determined, giving distance between stations when plane is directly over line.

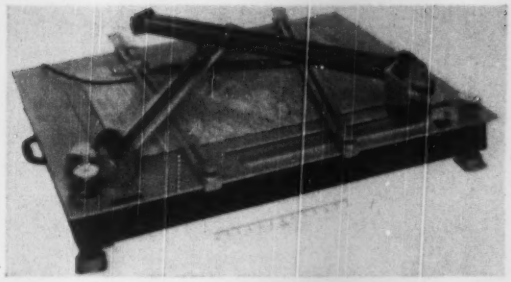
crossed, then increases. Readings of the dials, as well as the times (every 3 seconds) and other data are recorded on film by a single-exposure movie camera. Four groups (two on each of two days) of four flight crossings each (Fig. 2), in the form of a figure eight, comprise a minimum program of measurements. On each crossing about 31 readings are used for calculating the minimum $R+D$.

To simplify the explanation of calculating the minimum $R+D$, Fig. 3 is given. If the readings are plotted on cross-section paper, with the vertical ordinates $R + D$ and the horizontal ordinates times of exposure, it will be found that the curve of best fit is approximately a parabola with its apex down. The $R + D$ ordinate of the apex will be the minimum $R + D$, which is hence the sum of the distances from the plane to the two ground stations when the plane is directly over the line. The equation of the curve of best fit is calculated, and the minimum $R + D$ is calculated from this equation.

For very short lines, 20 miles or so, the "internal" line-crossing method is not feasible, and an "external" crossing as shown in Fig. 4 has been experimented with. The crossing is made about 70 miles from the nearer ground station and the values of $R-D$ are calculated, instead of $R + D$ as in the "internal" crossings. This method has many valuable applications if fully successful, since it allows a greater density of control points.

Close Measurement of Transmission Time

It is startling to realize how minutely the time of transmission must be measured. Since high-frequency electromagnetic waves travel along a line of sight and at approximately the velocity of light, 186,219 miles per sec, it follows that to measure a distance to within, say, 25 ft of the truth the shoran apparatus must be capable of measuring the time of travel from plane to ground and return within 1/40,000,000 of a second. This the present shoran apparatus can do, and by repetition of the measurements it is quite possible to get a mean value of distance within about 15 ft of the truth. An error of 15 ft in a mile would be intolerably large, but the same error of 15 ft on a 200-mile line is only one part in 70,000, which is high accuracy. In other words, some errors of shoran are not proportional to the distance, but are just as large over a mile as they are over 100 miles. The proportional error on the long lines is small, however. This indicates why the "internal" method can be used only for the measurement of long lines, say from 100 to 300 miles. It is hoped that this restriction may later be eased considerably when and if "external" line-crossings prove successful.



STRAIGHT - LINE FLIGHT COMPUTER enables pilot to direct aircraft on straight line required for mapping flights.

Corrections Applied

Figure 5 illustrates the minimum R and D values which have been described above. Several corrections must be applied to these values and finally these slope distances must be reduced to sea level. A very important correction is that necessitated by the lag or delay in both ground and airborne electronic apparatus, which increases the elapsed time, and hence the measured length of the line. Each set has to be calibrated, and recalibrated from time to time, to determine the delay for that set. This correction may be of the order of −900 ft.

It will be obvious that variations from standard meteorological conditions—temperature, pressure and humidity—have an important effect

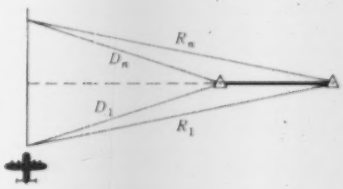


FIG. 4. PLAN of external line crossing indicates flight pattern now being tried out to secure high accuracy where lines are shorter than about 100 miles.

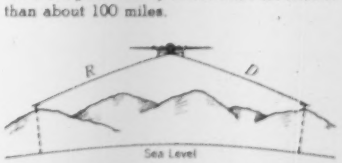
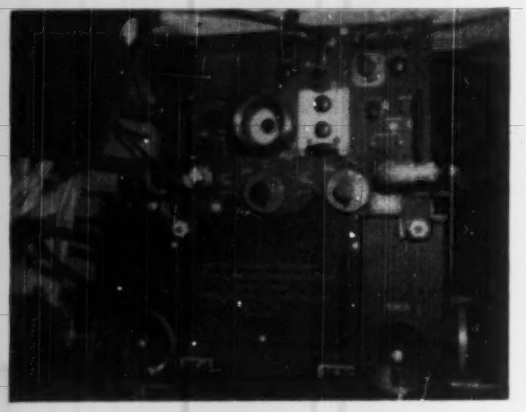


FIG. 5. ELEVATION illustrates relation between measured R and D and sea-level distance required.



AIRBORNE SHORAN indicator and recorder assembly is used for both line crossing and mapping operations. Operator continuously adjusts two controls to maintain proper alignment of pips on cathode - ray tube. When this alignment is achieved, dials indicate *D* and *R* distances, which are recorded photographically.

on the recorded lengths *R* and *D*, and on the path of the pulse from plane to ground station and return. These variations also affect the altimeter readings in the plane (which vary with meteorological conditions at the same altitude above sea level and may be 100 to 800 ft in error), as well as the assumed value of the velocity of the electromagnetic waves built into the apparatus. Any error in the calculated height of the plane produces an error about one-tenth of its value in the length of the line. This is clearly important.

Since a correct assessment of meteorological conditions is most important, data supplied by the Meteorological Service in the neighborhood is supplemented by readings secured by shoran ground parties. The ground parties are provided with altimeter, wet-bulb and dry-bulb thermometers, and radio transmitter. These instruments are read every 15 minutes while line-crossing operations are being carried on, and the readings are radioed either to the shoran plane or to the base. In addition the shoran plane, before the line crossings, takes wet-bulb and dry-bulb thermometer readings and indicated air speed at intervals of 1,000 ft from the ground, and up to 1,000 ft above the altitude at which the line crossings are to be made. After the line crossings are completed for the day a descent is made, during which the same meteorological data are collected. From all these data, plus those supplied by the Meteorological Service, the various corrections to the shoran measurements can be calculated and applied. The method employed was evolved with the cooperation of the Meteorological Service.

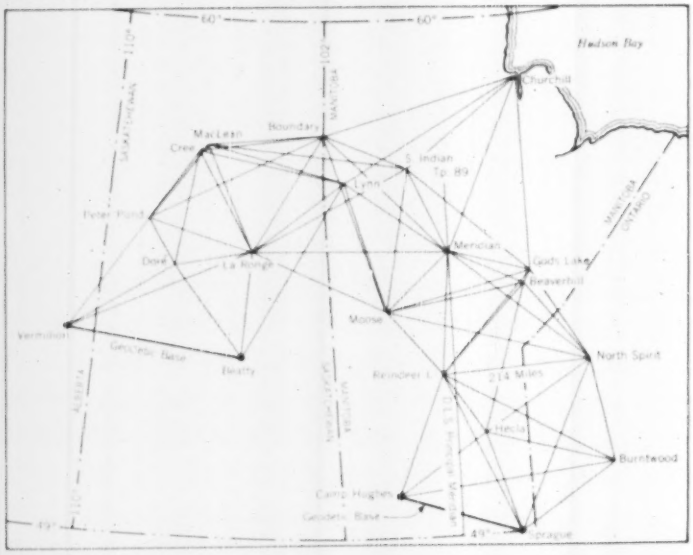
The reduction of the field measurements is made immediately after a flight by the geodetic section of the team. As the information accumulates, minor figure adjustments are made. Further indication is also obtained of the relative soundness of the observed values for the lines forming a figure or combination of figures. In a few cases this has revealed the necessity of reflights to maintain accuracy. Table I shows the relative size of the various corrections for the line Reindeer to North Spirit.

Each figure-eight flight (Fig. 2) gives four values for the length of the line, and present Canadian practice requires 16 crossings, two figure-eight flights on each of two days, to secure observations under varying meteorological conditions. If the measurements on the two days vary too greatly, reflights are required. The accidental error of the length may be very small but this must not be confused with possible systematic errors which are imperfectly known and against which constant vigilance must be exercised. For example, if the delay correction in a ground set were erroneously determined, there would be a systematic error in the length of all lines radiating from that ground station.

Method Tested Over Large Area

During 1948 a reconnaissance of an area through Manitoba and central northern Saskatchewan was made, and the scheme of stations and connecting lines shown in Fig. 6 was selected as a net over which a combination experimental and useful shoran survey could be made. The net is based upon two geodetic stations, Sprague and Camp Hughes in southern Manitoba, and is to be closed on the two geodetic stations Beatty and Vermilion to the northwest. The axial length of the net is about 1,100 miles, and the longest line to be measured is 310 miles. In contrast with visual triangulation methods, more lines are required to secure accuracy of fixation, since the mathematical conditions to be satisfied are fewer. The selection of lines to be measured has been made to give many

FIG. 6. **TEST SHORAN NET** is now being measured in midwestern Canada. Starting from geodetic base line Camp Hughes-Sprague, shoran net is being extended to close on Vermilion-Beatty, another known geodetic base line.



right-angle intersections at each station, and two azimuth controls have been introduced, one at God's Lake and one at MacLean. During 1949 the lines inclusive and south of Moose–Meridian–God's Lake were measured. The remainder of the net is expected to be completed in 1950. An assessment of the value of shoran will be made in the expansion of control over large areas, when it is forced to stand on its own feet. The positions of Beatty and Vermilion will be derived from the shoran work alone, before the net is finally adjusted to fit the present geodetic coordinates. The discrepancy between the shoran and the geodetic values of these stations will be a definite answer to the degree of accuracy which can be expected in shoran control. It is possible to make several adjustments giving misclosures at Beatty-Vermilion, two of which could be for the net with and without azimuth controls.

Short-Line Measurement Hoped for

External line-crossings and azimuth controls are introduced in this net with the hope that short-line measurement will be possible, with corresponding accuracy on long lines, and that the azimuth controls will correct any tendency to deviate from true direction. Both are innovations, and the answer as to their effectiveness should be available when the net is completed. From the work already completed, it is felt certain that shoran will give control superior to astronomic fixation. Hence, even before the test net has been completed in 1950, an extension is to be laid out northwesterly towards the Arctic.

Elevations of shoran stations secured by barometer where checks have been available, indicate that they are correct within 25 ft. Such an error is not serious in shoran observations. Aneroids, frequently standardized, are read at the station every three hours at the times meteorological data for weather maps are secured. These readings are continued for two weeks or so, and are then reduced by the Meteorological Service with reference to its weather charts. Naturally best results are secured where there is the greatest density of meteorological stations, and the results in northern areas may be expected to be less accurate where these stations are sparsely located.

Radar altimetry may eventually be developed to a stage where it will provide suitable elevation data, not only for shoran purposes but also for topographic mapping. Its successful use will require traverse and level loop closures to the larger lake surfaces previous to its use in a shoran area.

Another development which is in the test stage is radio sonde equipment, with a parachute which would be released from the plane while on line crossings. This would provide the needed meteorological data, secured at present by the plane before and after the line crossings.

TABLE I. CORRECTIONS TO SHORAN MEASUREMENTS FROM REINDEER TO NORTH SPIRIT, CANADA

Minimum shoran distance (uncorrected)	215	2826 miles
Minimum rate station reading	108	2390 miles
Minimum drift station reading	107	6436 miles

	Rate, Ft	Drift, Ft
Corrected altitude of plane (H)	18,330	18,330
Antenna altitude at stations (K)	769	1,227
	Rate, Miles	**Drift, Miles**
Slope distance, R and D	108.2390	107.0436
Delay	−0.1866	−0.1853
Correction to assumed velocity	+0.0056	+0.0056
Frequency correction	−0.0004	−0.0004
Curvature correction	+0.0030	+0.0030
Slope correction	−0.0512	−0.0491
Sea level correction	−0.0493	−0.0499
	107.9601	106.7675
Reduced shoran distance	214	7276 miles

Mapping with Remote Shoran Control

Where a shoran net has been laid down it can be used without change for the control of aerial photography over an area devoid of control. As shown in Fig. 7, ground beacons are set up at two shoran stations; shoran equipment is installed in the photographic plane, and radio pulses are sent out continuously from the plane, and at the instant of each camera exposure. The shoran equipment in the plane records the distances to each of the two ground beacons; thus each photograph can be placed in its correct position in latitude and longitude. Tests made in Canada to date have inspired confidence that shoran-controlled mapping will play an important role in the mapping of northern Canada.

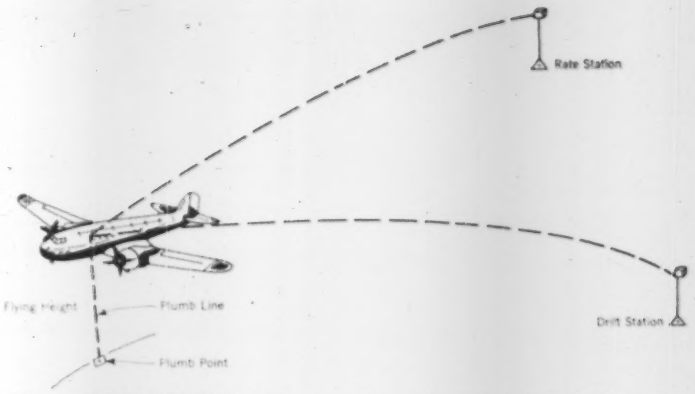


FIG. 7. SHORAN STATIONS can be used for remote control of aerial photography. Single-exposure cameras are synchronized so as to photograph the ground and the shoran instrument readings simultaneously.

The operator of airborne shoran radar equipment is required to make continuous adjustments to two controls to maintain proper alignment of the "pips" on a cathode-ray tube. When this alignment is achieved, dials indicate the two distances. The record is obtained photographically by means of a triggered flash, operating with a single-exposure camera incorporated in the same device as the "aided-laying" control systems, through which the operator makes the adjustments. This unit is called the shoran recorder and is used for both line-crossing and mapping operations.

The aircraft may be directed on the lines required during mapping flights through use of the straight-line flight computer. An adjustment is made for the distance between the two ground stations. As long as the shoran operator maintains pip alignment, the computer is so driven that the position of the aircraft is located as a point on the map, on which the flight lines are drawn. The deviation of this point from the required flight line is detected electrically, and displayed to the pilot on a meter as track error, enabling the correct track to be made good.

(The present article is based on a paper presented by Mr. Rannie before the Surveying and Mapping Division at the joint EIC-ASCE Meeting in Toronto.)

Engineers' Notebook

Design of Dam Outlet Trash Rack Verified by Model Tests

M. B. McPHERSON, Jun. M. ASCE

Assistant Professor of Civil Engineering, Lehigh University, Bethlehem, Pa.

CONSTRUCTION is now under way on the Little Pine Creek Dam near Williamsport, Pa. This flood control structure was designed by Gannett Fleming Corddry and Carpenter, Inc., of Harrisburg, Pa., for the Pennsylvania Department of Forests and Waters. A unique feature in the design is the trash rack, located above the uncontrolled orifice outlet. See Figs. 1 and 2. The trash rack has a dual purpose—to prevent obstruction of the orifice and to avoid the formation of destructive vortexes. Model tests of the outlet tower were performed at the Hydraulic Laboratory of Lehigh University as a check on the design.

Model Mounted in Large Tank

The model, to a scale of 1:24, was mounted in the bottom of a large tank. For the trash rack tests, a hole was cut in the bottom of the outlet tower and the testing tank. Since the pressure at the lower edge of the orifice was then atmospheric, when the model was tested the effective head was the water height measured above this reference.

For comparison, two types of orifices were tested—a bell-mouthed orifice (given in the design) and an I.S.A. flow nozzle. The following tests were performed on both these orifices with heads up to an equivalent maximum pool elevation of 793.5 ft ($\Delta H = 9.4\ D_0$):

Both Orifices Tested Four Ways

Case 1. With trash rack removed, that is, all of the structure above El. 710 (see Fig. 1).

Case 2. With trash rack in place and all four sides unobstructed.

Case 3. With trash-rack openings on Sides D and A (see Fig. 2) completely closed off to simulate partial clogging.

Case 4. With trash-rack openings on Sides D, A and B completely closed off to simulate a condition of extreme clogging.

The relative coefficients for the two orifices are about the same, as shown in Table I. It is interesting to note that the fully open trash rack (Case 2) had the effect of reducing the coefficient of discharge for the unobstructed controls (Case 1) by about 4 per cent, while for the trash rack obstructed on Sides D and A (Case 3) the coefficient of discharge for the unobstructed trash rack (Case 2) was reduced by about 1.4 and 4 percent.

Tests Show Advantages of Trash Rack

During the tests without the trash rack (Case 1), relatively large vortexes were formed intermittently, as would be expected. The equations shown for this test arrangement are for the highest heads at a given discharge, that is, when vortexes were absent. In the tests with the trash rack, for Cases 2, 3, and 4, with ΔH values from 2 to 4 D_0, small "pimple" vortexes were observed under the lucite top of the trash rack and leading from the rack pier openings to the water surface. However, for

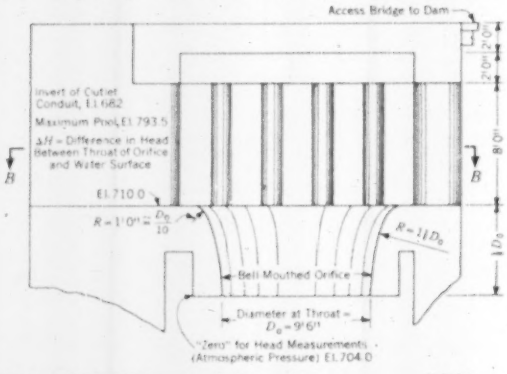
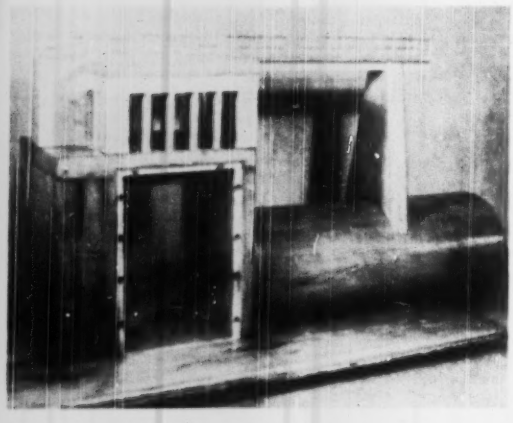
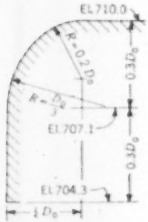


FIG. 1. ELEVATION section A-A (from Fig. 2) shows bell-mouthed orifice (above) chosen as result of model tests. Sketch at right is I.S.A. nozzle (adapted from *Flow Measurement*, 1940, American Society of Mechanical Engineers), alternative design tested in model studies, with results shown in Table I.



MODEL of Little Pine Creek Dam outlet structure (at left) was tested with two different types of orifices, at various heads, at Hydraulic Laboratory of Lehigh University.



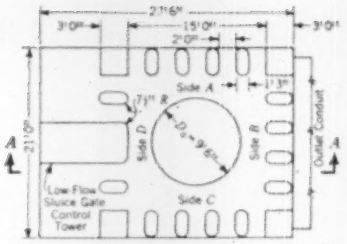
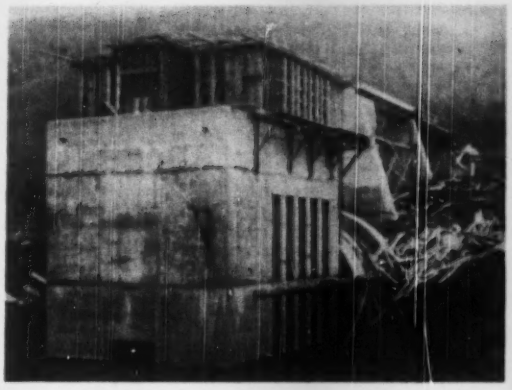


FIG. 2. PLAN section B-B (from Fig. 1) of outlet tower shows design dimensions of prototype. Model scale was 1:24.



OUTLET TOWER for Little Pine Creek Dam has slot openings in side which will serve as bypass during construction, and will be covered with permanent steel plates when dam is completed. Bell-shaped orifice chosen as result of model tests is faced with steel. Construction view of tower shows forms in place for trash-rack piers, before pouring of top slab. Outlet structure is now finished and dam is scheduled for 1950 completion.

ΔH values greater than 4 D_0, these "pimple" vortexes did not occur.

The Reynolds number range of the tests was from 1.5 to 5 × 10^5, which will be recognized as a range for relatively constant discharge coefficients. The lower limit of ΔH = 2 D_0, in Table I, represents the lowest head, in general, for fully developed orifice flow. However, the tests were run with a ΔH as small as 1 D_0, but from ΔH = 1 to 2 D_0 the flow is at first a weir type, with a transition to orifice flow.

Orifice Obstruction Prevented

The model tests indicated that the trash rack as designed would satisfactorily prevent obstruction of the controlling orifice and eliminate vortex formation at the higher, more dangerous, heads. The tests also indicated that a high coefficient of discharge would be obtained under conditions of severe clogging. The discharge coefficient for the design control—the bell-mouthed orifice—with the trash rack was only 4.3 percent less than that for an unobstructed orifice. With three sides completely obstructed, it may be observed that the discharge at the maximum pool elevation is decreased 24 percent over that for the unobstructed trash rack. It is anticipated that the discharge coefficients shown in Table I will not be reduced more than 5 percent in the prototype structure.

TABLE I. RESULTS OF MODEL TESTS WITH TWO TYPES OF ORIFICES

For ΔH Varying from 2 to 9.4 D_0

D_0 = diameter of throat
A_0 = area at throat
ΔH = total change in head, measured from throat of orifice
Q = quantity of water
El. of bell-mouthed throat = 704.0
El. of I.S.A. nozzle throat = 704.3

Cases	Bell-Mouthed Orifice	I.S.A. Flow Nozzle
1	$Q \cong 0.977\ A_0\sqrt{2g(\Delta H)}$	$Q \cong 0.99\ A_0\sqrt{2g(\Delta H)}$
2	$Q = 0.935\ A_0\sqrt{2g(\Delta H)}$	$Q = 0.950\ A_0\sqrt{2g(\Delta H)}$
3	$Q = 0.922\ A_0\sqrt{2g(\Delta H)}$	$Q = 0.913\ A_0\sqrt{2g(\Delta H)}$
4	$Q \cong 5.28\ A_0(\Delta H)^{0.46}$	$Q \cong 5.20\ A_0(\Delta H)^{0.46}$

Tunnel-Driving Alignment Speeded by New Method

F. K. MATEJKA
Construction Engineer, Bureau of Reclamation,
Estes Park, Colorado

ONE OF the difficult problems confronting engineers during the driving of a tunnel is the establishment of a horizontal control that can readily be projected to the working face without delay to construction operations.

In the past, it has been customary to maintain alignment by driving spads into wooden wedges on the center line in the arch of the tunnel, from which a plumb-bob and string can be hung. This procedure complicates construction progress since all construction equipment—such as motors, cars, and drill jumbo—is in the center of the tunnel. Backing up of the equipment after each round of tunnel excavation to a point from which sights can be made, may be required and if so considerable time is lost. In addition, an inspector must return each time to hang the plumb-bob; and if the lighting in the tunnel is poor at that point, he must shine a flashlight on the plumb-bob string. Time is also lost in locating the spads, and after a new spad is set, all succeeding inspectors must be made acquainted with its location. Moreover, since it is impractical to use more than two spads at one time for alignment, the dislocation of one would cause the alignment at the face to be in error.

To eliminate such delays in construction progress, the writer has adopted a device which serves as a practical backsight. This device can be installed in the arch of the tunnel and can be seen without backing up the equipment or withdrawing workmen from the heading. This improvement has proved satisfactory beyond expectation and has been used on all tunnels in the Estes Park area of the Bureau's Colorado–Big Thompson Project.

Component Parts of Backsight

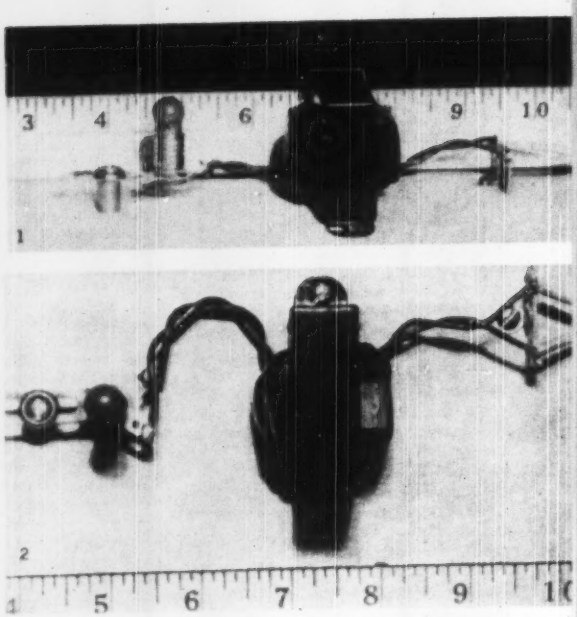
The backsight consists of: (1) a transformer rated at 110 v a-c primary and 2.5 v a-c secondary; (2) a radio pilot-light socket having a slotted mounting bracket; and (3) a 3.8-v red flashlight lamp. The entire cost of this equipment is less than $2.

The transformer can be connected at any point along the tunnel since the contractor uses 110 v a-c in pro-

viding lighting service for his work. It will be noted that the transformer supplies only 2.5 v while the lamp used requires 3.8 v. This combination is used to prevent the lamp from burning at full brilliance, thus minimizing the issuance of apparent rays. In addition, the life of the lamp is extended materially. Under these conditions, the lamp merely glows and appears as a miniature red ball to the instrumentman, thus being easily distinguishable from the clear lights of the lighting system. As-purchased, the pilot-light socket bracket is turned up parallel to the socket. However, the bracket must be bent at 90 deg so that the slotted portion will permit horizontal adjustment.

Unit Nailed to Roof

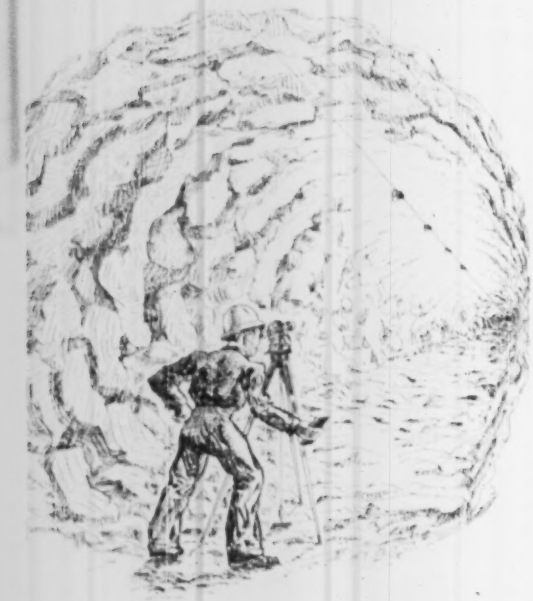
The transformer and socket are mounted on a short piece of wood which can readily be nailed to a piece of lagging in supported reaches of the tunnel or to two wooden wedges driven into the arch in unsupported reaches. A screw, with suitable washers, to be used when making adjustments, is inserted through the slotted portion of the bracket. Installation of the mounting board is made at times when the services of the inspectors are not required in the heading proper. A transit is set on an existing monument and another monument is backsighted, and with the lamp in its midway adjustment the board is nailed to its supports.



BACKSIGHT UNIT consists of transformer rated at 110 v a-c primary and 2.5 v a-c secondary; radio pilot-light socket with slotted mounting bracket; and 3.8-v red flashlight lamp. Transformer and socket are mounted on short piece of wood which can be nailed to lagging in supported reaches of tunnel or to wooden wedges driven into arch in unsupported reaches. Upside-down view of backsight unit (1) appears at top, right, and view as seen from below, (2), looking upward from tunnel invert, is shown below.

When it is firmly installed, an adjustment in the slot is made for perfect alignment.

The backsights are installed in groups of four for each heading after the driving has advanced a quarter of a mile or more. They are installed at approximate distances of 200, 300, 500 and 1,000 ft from the heading. The inspector can set up his transit near the face after a muck-out, and align himself with the four lights, which can be seen above the construction equipment. Four units are required as it is always possible that one of the lights may have become dislocated. Should less than four be used, the inspector at the face would be unable to determine immediately which one was in error. With four units in operation, however, some combination of three will determine the line.



CONSTRUCTION INSPECTOR aligns himself with four backsight units suspended from arch of tunnel. He then can project horizontal control to working face without causing delay in construction operations.

The advancement of these backsight units is irregular and depends upon sight conditions. The unit farthest from the face remains in place until interference by construction equipment or curvature of the tunnel impairs the line of vision. When concrete monuments are placed in the floor, and correlated in precise alignment surveys, the alignment of the four units is checked, and if necessary, minor adjustments are made.

In a long tunnel, the use of the backsight units materially reduces the time lost in providing alignment at the heading. During construction of the east end of the Alva B. Adams Tunnel on the Colorado–Big Thompson Project, for example, approximately 6,600 rounds were drilled. It is estimated that a time saving of at least 3 minutes was realized on each round in the tunnel, which resulted in a total saving of approximately 14 days. As one less Bureau inspector per shift was required, a saving of about 12 man-years was made possible. Although the saving of time may not be susceptible to accurate monetary evaluation, the use of the backsight units provides accurate alignment with a minimum of effort. As the engineering inspection is performed at no loss of time or cost to the construction forces, the cooperative relationship with them is enhanced considerably.

...THE READERS Write

Shortcuts for Solving Cubic Equations Compared

TO THE EDITOR: D. B. Steinman's suggestion for solving cubic equations, which appeared in the June "Engineer's Notebook," is the easiest and neatest method I have seen for solving many equations of this type in which there is a reasonable convergence—the successive values of x. Unfortunately there are some cubic equations that cannot readily be solved by this method, and I was unfortunate enough to run into one in solving a problem in reinforced concrete. The equation was:

$$x^3 = 4.2x^2 - 30.9x + 293$$

which is satisfied by $x = 6.431$.

An attempted solution by the method of Dr. Steinman's Example 1 showed that the first eight approximations of x varied from +19.6 to −17.0 in an irregular fashion. The "Method of Speeding Convergence" was then used with a trial root $x_0 = 6$. Successive steps gave as approximations to x, 7.2, 6.7, 5.67, 6.47, 7.38. The lack of convergence does not become apparent until the fourth term is reached. In Dr. Steinman's equations, the constant term does not exceed six times the value of x. Here the ratio is 45 to one, and I wonder if this large ratio always indicates poor convergence.

When slide-rule accuracy is satisfactory, and the approximate size of the root can be estimated from the physical limitations of the problem involved, the answer can be found by trial substitution of values of x in the original equation. Five such substitutions resulted in a value of 6.45. While this may be a bit laborious, it is a simple method and one that is not dependent on the mathematical idiosyncrasies of the equation involved.

Horner's method of solution has the advantage that it is direct and positive and can be carried to any desired degree of precision. For the equation mentioned above the answer to four figures was 6.451. The solution of Dr. Steinman's Example 1 by the more laborious Horner's method involves about 3 times the work required by the "Engineer's Shortcut."

ANTHONY HOADLEY,
Schenectady, N.Y. Assoc. M. ASCE

Asks for Criteria in Solving Higher Equations

TO THE EDITOR: We have read the article on the method of solving equations with numerical coefficients by D. B. Steinman in your June issue, and found the method useful. It occurred to us to compare it with the Newton-Raphson method, which can be briefly explained with reference to the accompanying Fig. 1. If $x_1 (= OA)$ is an approximation to the root, then

$$OB = OA - AB = x_1 - \frac{f(x_1)}{\left[\frac{dy}{dx}\right]_{x_1}}$$

is a better approximation.

Writing a typical equation as $f(x) = x^3 + a_1x^2 + a_2x + a_3 = 0$, the method described by Mr. Steinman gives the following table:

$-a_1$	$+ a_1^2$	$- a_1^3 + a_1a_2$	$+ a_1^4 - 2a_1^2a_2 + a_2a_3$
	$- a_2$	$+ a_2a_1$	$- a_1^3a_2 + a_2^2$
		$- a_3$	$+ a_1a_3$
$-a_1'$	$+ a_1^2 - a_2$	$- a_1^3 + 2a_2a_1 - a_3$	$+ a_1^4 - 3a_1^3a_2 + 2a_1a_3 + a_2^2$

The Newton-Raphson method for the same equation gives the next approximation (taking $-a_1$ as the first approximate root): $(-a_1^3 - a_2)/(a_1^2 - a_2)$, the author's method giving $(a_1^3 + a_2)/-a_1$.

For Example 1 of the article, the numerical values are + 128.27 and + 27.5, that is, the new method described converges more rapidly than the older method. The next approximation is laborious to obtain in symbolic form in the Newton-Raphson method. It appears therefore that the author's process is equivalent to taking a line PB at a slope less than dy/dx. It would be interesting if the method could be justified mathematically, and explained as a graphical process. In addition, it would be useful if some criterion could be established as to the preferable type of method on the grounds of speed and accuracy, for any particular equation or type of equation, since the above process is not invariably more rapidly convergent than the Newton method.

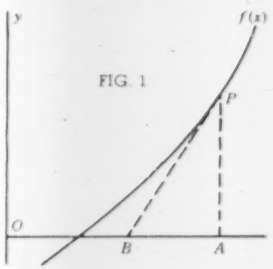


FIG. 1

BASIL STANDING, Assoc. M. ASCE
and L. S. PIGGOTT
Engineering Department, University of Manchester
Manchester, England

Engineering Defined as Fight Against Nature

TO THE EDITOR: The development of definitions of the words "engineer" and "engineering" is an interesting subject. A few years ago I tried to define "engineering" in a short lecture on engineering and construction. Of course, as a civil engineer myself, I was thinking especially of the *civil* engineer and *civil* engineering. For whatever worth it may have, I submit my attempt at a definition.

"It is certainly difficult to define the full meaning of 'engineering.' However, we will not go very far afield if we take as the basis for our definition the Latin word *ingenium*, which means 'natural talent or ability.' The word engineering would then have the very wide meaning of 'the application or use of natural talent.'

"The meaning of the word engineering as we use it today is not so broad. In fact it is narrower than Tredgold's classic definition of 1828: 'the art of using the materials and forces of Nature for the welfare of mankind'; and also narrower than the definition recently given by my colleague Antonio C. Cardoso: 'Engineering is the art of directing and organizing human labor and of using Nature's energies and materials for the welfare of mankind.'

"As a matter of fact such a definition would include farmers, for instance, who

direct laborers and use seeds, soils and rain to feed and dress mankind.

"It seems to me that engineering (civil) is 'the art of organizing and directing human labor and utilizing Nature's forces and materials for the ingenious fight against Nature herself, on behalf of mankind.' Actually when the engineer dams a river, or cuts down a mountain, or fills a valley, or bores deep into the earth, or changes the course of rivers and the limits of the sea, or builds shelters against sun and tempest, he is, without a doubt, fighting against Nature, but it is a good fight to promote man's well being."

"Although engineering is a continuous fight, it is essentially peaceful; it progresses in peace and for the sake of peace. However its capacities and achievements are of capital importance for war when war is forced on us."

F. T. DA SILVA TELLES, M. ASCE
Sociedade Constructora Brasileira, Ltd.
Sao Paulo, Brazil

Runoff Forecasting Calls for Engineering Judgment

TO THE EDITOR: G. N. Person's paper, "Cyclic Variations in Columbia River Flow Studied," in the April issue, can be said to have a commendable goal—long range forecasts of runoff in the Columbia River Basin.

It is not beyond the realm of belief that some day a set of causative relationships between solar phenomena and terrestrial weather may be found. That day, however, is not yet at hand. This is evidenced by the fact that no method of accurately forecasting the weather for more than 48 hours in advance has yet been devised that meets with the approval of the larger part of the meteorological profession. In the meantime, there is no knowledge of cause and effect in an analysis such as Mr. Person has performed. There is no reason to believe that, simply because a weather or runoff quantity has been fitted by a more or less arbitrary set of harmonics to its period of record, it will continue to fit the same harmonics. Consequently a harmonic analysis of weather or runoff should be regarded with skepticism as a forecasting tool unless it can be supported by a considerable body of fact and reasoning.

Mr. Person's statement that May, June and July are the three wet months in the Columbia Basin is erroneous if he is referring to the three months of highest precipitation. In that sense, the three wettest months are November, December and January, as shown by the following tabulation:

Month	Av. Precipitation, in. Portland, Ore.	Spokane, Wash.
January	6.60	1.98
February	5.36	1.63
March	3.91	1.25
April	2.87	1.09
May	2.19	1.34
June	1.52	1.27
July	0.61	0.54
August	0.64	0.56
September	1.98	0.91
October	3.12	1.25
November	6.10	2.00
December	6.72	2.13
Year	41.62	15.95

I suspect that a good many engineers believe that hydrology in general, and river forecasting in particular, can be reduced to a simple slide-rule and handbook operation. They cannot, and it is important that the profession should realize this fact. On the contrary, modern hydrology is a highly complex science, and its practice demands just as much well-informed judgment as any other branch of the civil engineering profession.

CHARLES D. HOPKINS, JR.
Assoc. M. ASCE
U. S. Weather Bureau
River Forecast Center
Portland, Ore.

Good "Controlled Concrete" Depends on Good Inspection

TO THE EDITOR: Some consider the term "controlled concrete" as being synonymous with the words "high quality concrete." This is as it should be, but the mere use of the term "controlled concrete" will not obtain a specific control unless it is defined.

The only function that makes controlled concrete better than average concrete is supervison. The degree and type of supervision determines the uniformity and quality of the concrete. Only by the most rigid supervision can there be any assurance of uniform, specified concrete.

The practice of awarding inspection and testing services on a competitive-bid basis is prevalent. Further, many specifications require the general contractor to arrange and pay for these services.

Engineering inspection and testing is not a commodity but is a personal technical service. Like any other professional service it should be retained primarily on the basis of confidence, and this confidence should, in turn, be based on the reputation of the personal service agency for integrity, reliability, facilities and ability. Engineers and architects should recognize that inspection and testing are engineering services and that as such they should be arranged for by the engineer or the architect and not by the contractor.

The sole responsibility for executing the design requirements lies with the engineer, and unless active and vigilant control of inspection and testing is exercised by him the entire purpose of the service is defeated and the owner will not obtain his desires.

It is true that there are so-called lists of approved laboratories from which to obtain bids, but are there any requirements for approval? There has been, as far as the writer is aware, no general investigation to determine the facilities of the various inspection agencies or the qualifications of their inspectors.

It is true that many contracting firms operate in accordance with the highest engineering standards and that in some cases the engagement of the services of an inspection agency by the contractor will not cause any conflict of interests. However, the arrangement for inspection and testing by the contractor is wrong in principle as it places the inspectors in the position of a subcontractor. It is the primary responsibility of the inspectors to enforce conformance with the requirements of the specifications, and placing the inspectors in the position of a subcontractor very often makes the enforcement of specification requirements more difficult.

Although the inspector does assume the responsibility of permitting the contractor to perform his work in the most economical manner possible, consistent of course with the specification requirements, this responsibility is of a secondary nature and must not overshadow the major responsibility of informing the architect and engineer of any departures from the requirements of the plans and specifications.

The method of awarding inspection services which is here objected to is prevalent, not only in connection with concrete, but in connection with all types of construction materials. A revision of this procedure would be of benefit to all concerned.

ALDEN M. KLEIN, Affiliate, ASCE
Robert W. Hunt Co.
New York, N.Y.

ASCE MEMBERSHIP AS OF JULY 9, 1950

Members	7,677
Associate Members	9,855
Honorary Members	39
Junior Members	11,520
Affiliates	72
Fellows	1
Total	29,162
(July 9, 1949	26,115)

SOCIETY NEWS

ASCE and EIC Have Joint Meeting in Toronto, July 12–14

Wide Horizons for Profession Foreseen in Annual Presidential Address

COMPLETE OPTIMISM FOR the future of the engineering profession in creative service was expressed by ASCE President Ernest E. Howard in the Annual Presidential Address that featured the opening session of the Toronto Convention on Wednesday morning, July 12. Recognizing the abilities of engineers, the national economy will absorb, in one capacity or another, all who are adequately prepared to enter the profession, the speaker told the joint ASCE-EIC group.

Pointing out that the unprecedented advances made in the American scale of living in the past century closely parallel the great engineering advances of the period, Mr. Howard stressed the vital importance of the applied scientist—the engineer—in the national economy. The tremendous fundamental research activities of industry and our universities would have been without point, he said, except for the engineer, whose function is to translate the results into peacetime application to the benefit of mankind.

President Howard does not concur with the often-repeated complaint that "engineers do not enjoy public esteem." The entire experience of engineers, especially in such public contact groups as Engineers Joint Council, clearly indicates that they enjoy the confidence of the public and healthy recognition as "professional" men. Some of the esteem they now enjoy, he said, probably stems from the direct contact the highway engineers of a generation ago had with the general public.

Urging the members of the two societies to keep themselves favorably before the public by performing the type of professional service engineers alone can give, Mr. Howard cited the recent recommendations for a National Water Policy made by the EJC Water Policy Panel as a case in point. "It will be fortunate indeed for our country if the principles prescribed by the EJC Committee are promptly adopted," he declared. Mr. Howard's address will be printed in full in TRANSACTIONS.

Notable Addresses Highlight Joint Program

The joint program, which marked the first annual meeting of the Engineering Institute of Canada to be held jointly with any United States society, featured a number of distinguished Canadian, American, and British speakers. These included Past-President W. W. Horner, who spoke at the Wednesday luncheon on "More Effective Utilization of Water Resources," which is printed elsewhere in this issue; Alfred P. Haake, consulting economist for the General Motors

VIEW OF SPEAKERS' TABLE AT JOINT ASCE-EIC BANQUET on Wednesday evening shows, left to right, Col. L. Grant, Mrs. James A. Vance, ASCE Past-President Franklin Thomas, Mrs. C. R. Young, ASCE President Ernest E. Howard, EIC President John E. Armstrong, and Mrs. Howard. In upper photo the two presidents greet the Hon. Ray Lawson, lieutenant governor of Ontario and ranking official of province, at Lieutenant Governor's Reception in Ontario Parliament Buildings on Tuesday afternoon.

ASCE EXECUTIVE COMMITTEE holds session in Toronto (left photo). Present (reading clockwise around table) are ASCE Treasurer Charles E. Trout, Vice-President Albert Haertlein, Executive Secretary Wm. N. Carey, President Ernest E. Howard, Vice-President Fred C. Scobey, Vice-President Robert B. Brooks, Past-President R. E. Dougherty, Vice-President Henry J. Sherman, and Past-President Franklin Thomas. Several Authors' Breakfasts, held during Toronto Meeting (right), continue pleasant feature initiated at Los Angeles Meeting. In foreground is W. H. Paterson, chief engineer for Toronto Transportation Commission. Facing camera, in usual order, are S. Jowitt, Canadian Department of Mines and Technical Surveys; B. W. Waugh, Surveyor General of Canada; A. W. Simonds, U.S. Bureau of Reclamation; and Charles B. Molineaux, chief engineer, Arthur A. Johnson Corp., New York City. Meeting papers by Messrs. Paterson and Molineaux on the Toronto subway appear elsewhere in this issue.

Corp., who addressed the Wednesday evening banquet on "The Stake of the Engineer in the Private Enterprise System", and the Hon. Lester B. Pearson, Secretary of State for External Affairs, Ottawa, Ontario, who discussed the international situation at the EIC annual banquet on Friday evening.

Production techniques based on scientific study and measurement are being increasingly accepted by British industry, government engineers, and other segments of the British public as giving the solid promise of more production of British goods, Lyndal Urwick, London industrial consultant and president of the British Institute of Management, said in the leading address at the Friday joint luncheon. Pointing out that "scientific management is rooted in engineering," Mr. Urwick reviewed the history of management developments in Britain. Since its establishment in 1947 the Institute of Management has attempted to coordinate the many existing management organizations and to establish professional standards in the field.

Many Technical Papers Presented

An American engineer, Rear Admiral Carl H. Cotter, M. ASCE, president of the Merritt-Chapman & Scott Corp., New York, read a paper on "Education for Management" before an EIC technical session on management. "It is no exaggeration to say," he observed, "that education for management must today be regarded as education for survival, not only of private enterprise management itself but of our entire democratic system."

The session on management was one of 22 meetings of ASCE and EIC Technical Divisions comprising the three-day technical program. The Air Transport, Highway, Hydraulics, Sanitary Engineering, and Structural Divisions had cooperative sessions with EIC technical divisions. Of interest to engineers in both countries were two Construction Division papers on the Toronto subway (the first to be built in Canada), by W. H. Paterson and Charles B. Molineaux, Members ASCE. Both papers are published in this issue.

As chief engineer of the Toronto Transportation Commission, Mr. Paterson arranged transportation for all trips, including a tour of the subway project that attracted an attendance of several hundred. The Thursday afternoon trip to Niagara Falls, followed by dinner at the Falls, also proved highly popular in spite of threatening weather. The group inspected one of the large power plants on the Canadian side, visited historic sites, and saw the illumination of the Falls.

ASCE Members Honored at EIC Banquet

ASCE Honorary Member John B. Challies, vice-president and executive engineer of the Shawinigan Water & Power Co., Montreal, and C. R. Young, M. ASCE, dean emeritus of the Faculty of Applied Science and Engineering at the University of Toronto, were two of four engineers awarded honorary membership in the Engineering Institute of Canada at the EIC annual banquet climaxing the three-day program. Similarly honored were Dr. Lillian M. Gilbreth, consulting management engineer of Montclair, N. J., and Sir Frank Whittle, of London, inventor of the jet engine. W. L. Pugh, M. ASCE, chief engineer of the Aluminum Company of Canada, Montreal, was awarded one of the Institute medals for a paper on the new Powell Wharf at Port Alfred, Quebec. A prize-winning paper by C. J. Pinenoff appears elsewhere in this issue.

At the conclusion of the banquet James A. Vance, M. ASCE, engineer and contractor of Woodstock, Ontario, was inducted into the presidency of the Institute for the coming year.

A full calendar of formal and informal social events rounded out the Toronto Meeting program. Outstanding for the beauty of its setting and for official government atmosphere was a reception for visiting and local engineers in the Ontario Parliament Buildings on Tuesday afternoon. Lt. Gov. Ray Lawson, ranking official in the province, was host to the group. Special events arranged for the ladies, under the chairmanship of Mrs. Ross Graydon, included concerts; theater parties, and an afternoon at the Royal Canadian Yacht Club.

ASCE-AGC Cooperative Committee Meets

Matters of mutual concern to engineers and contractors were discussed by the ASCE-AGC Joint Cooperative Committee at a luncheon meeting on Thursday, which has been called one of the most productive sessions of the joint group, now in its second year. Subjects under consideration included contract revision; methods of attracting students into civil engineering; general contract method for building construction; student employment on construction; and reduction of contractor's bid. Details of the session will be given in the September issue. ASCE was represented by Kirby Smith, co-chairman, E. L. Macdonald, and E. Lawrence Chandler, and AGC by Dwight W. Winkelman, co-chairmen, Lester Rogers, and A. N. Carter, co-secretary.

Registration of Over 1,000

Joint registration for the meeting came to slightly over 1,000. E. Ross Graydon of Toronto, headed the Joint Convention Committee, with ASCE Vice-President Albert Haertlein acting as Society representative on it.

For Proceedings Abstracts and Order Blank, See Pages 95 and 96

ASCE Board Actions at Toronto Are Summarized

PRINCIPAL ACTIONS OF the Board of Direction taken at its meeting in Toronto, Canada, July 10-11, 1950, are briefed here:

Honorary Members

Consideration of nominations for Honorary Members was postponed until total membership of the Society permits additional elections. The Constitution provides that "the total number of Honorary Members shall not exceed one for each 750 members."

Annual Meeting

The Board designated the October 1950 meeting in Chicago as the second Annual Meeting of the Society for 1950. At that time there will be a business meeting of the Society; newly elected officers will be introduced but not inducted into office; and customary ceremonies for award of ASCE prizes will be held. See Board resolution boxed on this page.

Local Section Allotments

Allotments to Local Sections during 1951 are not to be reduced below present levels.

Local Section Conference in October

One delegate from each of the 28 Midwestern and Northwestern Local Sections, listed elsewhere in this issue, will be officially invited to represent their Sections at a Local Section Conference during the Annual Meeting in Chicago, October 1950. Other interested members will be welcome to attend and to participate in the conference.

Maine Local Section Authorized

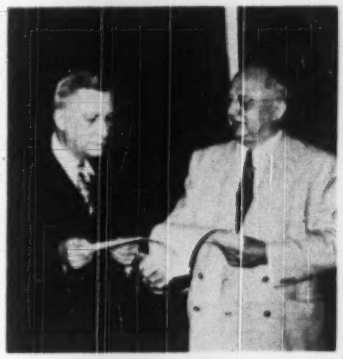
On recommendation of the Committee on Local Sections and with the concurrence of the Northeastern Section, the Board authorized a new Local Section covering the State of Maine.

El Paso Branch of Texas Section Organized

Members in El Paso have been organized as a Branch of the Texas Section.

EJC Water Resources Policy Panel

The Board commended the Engineers Joint Council Water Policy Panel and the many engineers who helped the panel to prepare its report on a desirable National Water Policy (CIVIL ENGINEERING, July, page 21, and article by W. W. Horner in this issue); urged EJC "to continue its interest and activity", and directed the Executive Secretary to assist EJC "in securing distribution and understanding of the report by those having responsibilities for the definition and administration of national water resources policies."



ARTHUR W. HARRINGTON, chairman of Committee on Constitution By-Laws, presents new draft of by-laws to President Howard for consideration at Board meeting in Toronto. New draft will be sent to all Local Sections.

Publicity for EJC

ASCE delegates to EJC were instructed to recommend to EJC that its Committee on Secretaries arrange for production of publicity matters for systematic publication in the journals of EJC societies.

U.S. Congress of Applied Mechanics

ASCE will be among the sponsors of a U.S. Congress of Applied Mechanics to be held in Chicago in June 1951. (See separate item in this issue.)

1950 ANNUAL MEETING—CHICAGO

"The Board of Direction hereby declares that exceptional circumstances exist with regard to the Annual Meeting of the Society, required under the Constitution of the Society to be held in October 1950, and it is Resolved: That, under Article VIII, Section 1, of the Constitution, the Board of Direction hereby assigns October 11, 1950, as the date, and Chicago, Illinois, as the place of the Annual Meeting of the Society for October 1950, and instructs the Executive Secretary, through notices in 'Civil Engineering,' to give the membership due and timely notice of the date and place of said Annual Meeting."

U.S. Council on Soil Mechanics

Approval and sanction were given to the formation of a U.S. Council of Soil Mechanics and Foundations Engineering.

Centennial of Engineering, 1952, Inc.

Plans of the Centennial Celebration Committee for an International Engineering Exposition and Convocation in Chicago in September 1952 have developed, under authorization of the Board, to the incorporation of a special corporation known as Centennial of Engineering, 1952, Inc. Its function is to direct the planning and execution of the program. The Board directed the committee and the corporation "to proceed as rapidly as possible with all steps found necessary to assure the success of the Centennial Celebration."

Interim By-Laws

A complete draft of Interim By-Laws, based on the recently approved Constitution, was considered by the Board. It approved the following recommendation of the committee that prepared the draft (Arthur W. Harrington, chairman):

"The Committee recommends that these By-Laws be received by the Board of Direction as Interim By-Laws subject to such changes as the Board of Direction may see fit to make at its October meeting, at which time the Interim By-Laws should be approved by the Board of Direction. It is recommended further that the Interim By-Laws be transmitted to the Local Sections for study and recommendations to the Committee, after which the Committee will prepare final By-Laws for submission to the Board of Direction."

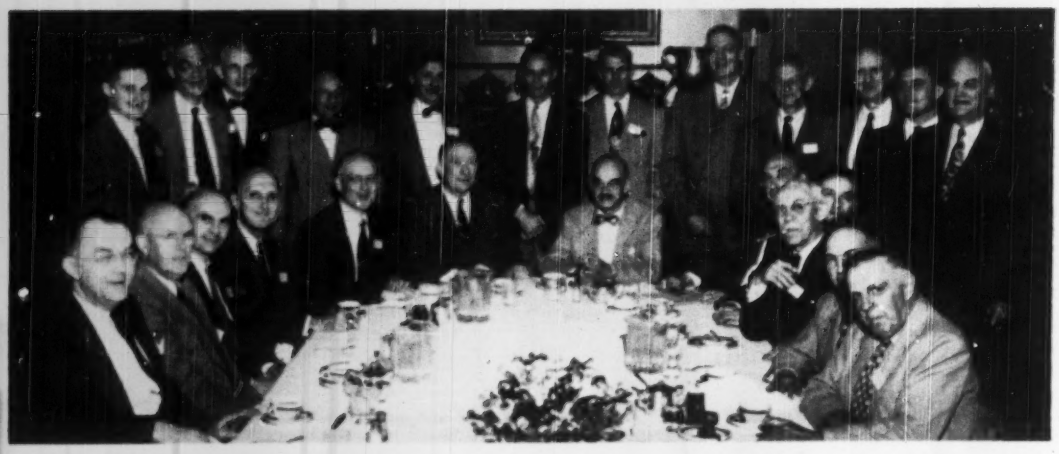
Appointments

Harry S. Rogers, to succeed Albert Haertlein, delegate to ECPD; Wm. N. Carey reappointed to represent ASCE on Board of UET; Ernest E. Howard to succeed W. W. Horner on John Fritz Medal Board of Award, with Albert Haertlein as alternate. W. H. McAlpine to succeed S. M. Woodward on Marston Medal Committee; L. R. Howson to succeed C. B. Burdick on Washington Commission of Award; and Enoch R. Needles and Harry Rogers to ASCE-AIA Cooperative Committee.

Visits

President Howard reported visits to 26 Local Sections and Student Chapter groups since the last Board meeting. Other members of the Board reported a total of 38 visits to such groups.

Council of Engineering Society Secretaries Meets in New York



ENGINEERING SOCIETY REPRESENTATIVES photographed during recent two-day Council of Secretaries are (left to right, seated) T. J. Eaa, Association of Iron and Steel Engineers; F. G. Horton, Engineering Society of Detroit; A. D. Hinchley, Illuminating Engineering Society; W. N. Landers, Society of Naval Architects and Marine Engineers; C. S. Pearce, American Ceramic Society; Harry S. Rogers, Polytechnic Institute of Brooklyn; Henry S. Harris, Engineers Club of Philadelphia; R. E. Dougherty, Engineers Joint Council; O. L. Angevine, Rochester Engineering Society; H. E. Bakenhus, American Institute of Consulting Engineers; N. D. Howard, American Railway Engineering Association; and M. C. Turpin, American Society of Refrigerating Engineers. Standing, in same order, are Allan R. Putnam, American Society of Tool Engineers; George S. Taylor, American Chemical Society; Raymond Olney, American Society of Agricultural Engineers; Kenneth F. Treschow, Engineering Society of Western Pennsylvania; Ernest Hartford, American Society of Mechanical Engineers; Burton W. Dunfield, Cleveland Engineering Society; Paul H. Robbins, National Society of Professional Engineers; Wm. N. Carey, American Society of Civil Engineers; E. H. Robie, American Institute of Mining and Metallurgical Engineers; E. L. Chandler, American Society of Civil Engineers; Don P. Reynolds, American Society of Civil Engineers; and George A. Stetson, American Society of Mechanical Engineers. Officers elected for 1950–51 are O. L. Angevine, president; Wm. N. Carey, vice-president; Ernest Hartford, secretary; and Frank G. Horton, treasurer. The fifteenth annual conference will be held in Rochester, N.Y., in June 1951.

Tellers Canvass Ballot for 1951 ASCE Officers

June 30, 1950

To the Secretary
American Society of Civil Engineers:

The Tellers appointed to canvass the Ballot for Official Nominees report as follows:

For President—Gail A. Hathaway, nominated by the Nominating Committee of the Board of Direction

For Vice-President—Zone II	
(Term January 1951–October 1952)	
Gerald G. Greulich	818
William R. Ghidden	591
Scattering	209
*Ineligible Candidate	29
Void	0
Blank	7
Total	1,654
For Vice-President—Zone III	
(Term January 1951–October 1952)	
Daniel V. Terrell	1,039
Ivan C. Crawford	550
Scattering	62
*Ineligible Candidate	31
Void	2
Blank	12
Total	1,676
For Director—District 1	
(Term January 1951–October 1953)	
Kirby Smith	450
†Joseph D. Lewin	154
Scattering	146
*Ineligible Candidate	15
Void	6
Blank	8
Total	779
For Director—District 4	
(Term January 1951–October 1953)	
Francis S. Friel	292
Scattering	28
*Ineligible Candidate	1
Void	0
Blank	4
Total	325
For Director—District 11	
Two to be elected	
(Term January 1951–October 1952)	
Milton T. Wilson	579
(Term January 1951–October 1953)	
Wallace L. Chadwick	586
Scattering	276
*Ineligible Candidate	159
Void	0
Blank	44
Total	1,075
Total ballots received in District 11	827
For Director—District 14	
(Term January 1951–October 1953)	
Norman R. Moore	405
Scattering	23
*Ineligible Candidate	1
Void	0
Blank	0
Total	429
For Director—District 15	
(Term January 1951–October 1953)	
Burton G. Dwyre	313
Scattering	107
*Ineligible Candidate	22
Void	2
Blank	0
Total	444
Ballots canvassed	6,134
Ballots withheld from canvass:	
Without signature	11
From members in arrears of dues	9

Total ballots not canvassed	20
Total number of ballots received	6,154

Respectfully submitted,
EDWARD S. SHEIRY, *Chairman*
R. EDWARD KUHN, *Vice-Chairman*

Solomon B. Arison — George H. Harp
Henry F. Boyer — Daniel J. Houlihan
Alex J. Castro — Frederick W. Ockert
W. G. Cummings — Edmund A. Prentis, III
J. C. Fegan — John H. Stamataky
Thomas J. Fratar — (*Tellers*)

* These votes were cast for incumbent officers who are presently ineligible for reelection in accordance with Section 9, Article VI of the Constitution.

† Note that this candidate has withdrawn his name from the Final Ballot.

Exploratory Group Reports Progress on Unification of Profession

THE GROUP OF representatives of large Engineering Societies, invited by Engineers Joint Council to explore the question of organization for increased unity of the engineering profession, had its second meeting on March 31, 1950. This group consists of the sixteen engineering societies listed in the box on this page.

Fourteen of the 16 societies were represented at the recent meeting.

The major order of business was the consideration of the report of the Planning Committee of eight members which was appointed at the previous meeting of the Exploratory Group on October 20, 1949. The Planning Committee had been charged with the duty of studying and reporting back a discussion of various approaches which had been suggested to the question of organizing for increased unity.

The Planning Committee had held five meetings at which the wide range of subjects involved in the question at hand had been discussed. The report of the Committee submitted at this meeting included a discussion and comparative analysis of three possible approaches to the formation of a unity organization.

Recognizing that many approaches are possible, the report of the Planning Committee included also suggestions as to a number of basic principles which were recommended to serve as a guide in any formation of a "unity organization" of engineers—this term being used to designate the organization through which increased unity of the engineering profession may be brought about, without in any sense proposing that this be adopted as a name of such an organization. The basic principles include the following:

The general aim of the unity organization will be to represent all engineers and engineering organizations who desire to be so represented in dealing with questions of interest to the profession as a whole. With this general aim in view, the following are proposed as basic principles to serve as a guide in determining the form of the unity organization and its relation to present engineering organizations.

1. The unity organization should include the affiliation of the major national engineering societies.

2. Affiliation should be open to all national engineering societies meeting certain general standards, on vote of the governing body.

As illustrative of the type of standards which may be established, it may be required that to qualify as an affiliate an engineering society should have a grade of membership with qualifications at least as high as those prescribed by the unity organization as necessary for professional recognition. Also, as a practical matter, affiliation may be limited to societies having more than a specified minimum number of members who are qualified engineers in accordance with this definition.

3. The unity organization should be formed by the modification and development of a present organization or organizations or by the integration of two or more present organizations rather than by the establishment of an entirely new organization.

4. The government of the unity organization should reside in a governing body on which all qualified engineering groups who wish to be associated with the organization are appropriately represented.

5. The activities of the unity organization should be determined by the governing body under the terms of a broad statement of general purposes in the constitution of the organization.

While a fairly complete statement of the general purposes of the organization should appear in its constitution, it does not appear useful to attempt to determine in advance what its specific activities would be at any given time. These would, no doubt, change from time to time in accordance with the wishes of the members.

6. Within its field of activity, the unity organization should be authorized to deal directly with government agencies and others as a representative of the engineering profession.

For example, in such matters as the nomination of engineers to serve as members of committees and commissions, or the expression of opinions on public questions involving engineering, the unity organization should be empowered to act directly without a referendum of its constituents.

7. To the extent practicable, the unity organization should take over present cooperative activities of groups of national engineering societies, where such activities appropriately fall within the scope of the unity organization.

8. The unity organization should have its own offices and staff.

These principles were accepted by the Exploratory Group subject to such modifications as might be arrived at in further discussions. The report of the Planning Committee also presented a number of other questions requiring further consideration.

In the general discussion of the Exploratory Group, every member presented his views as to the type and form of "unity organization" which seemed most desirable and the means by which it might be brought about. The discussion centered about the three approaches to the form of organization included in the report of the Planning Committee. These three approaches would be as follows:

A. Expand and modify the present Engineers Joint Council so that the members of a larger number of engineering societies would be represented and so that representation would be, to some extent, in proportion to membership.

B. Expand and modify the present National Society of Professional Engineers with the understanding that the existing engineering societies cooperate by urging their members to join and by referring to that Society items of a broad general nature which the Society is in a position to handle.

C. Modify the National Society of Professional Engineers so that registration is not a requirement for individual membership, modify the Engineers Joint Council as in Item A, and combine the NSPE Board of Directors with the EJC to form a single governing body.

After a full discussion the entire matter of preparing a further comparison of possible plans and a consideration of the questions on which agreement had not been reached was referred to the Planning Committee for study. It is expected that the next report of the Planning Committee will be made to the Exploratory Group shortly after the summer vacation period.

Am. Soc. of Civil Engineers
Am. Inst. of Mining & Metall. Engrs.
Am. Soc. of Mechnical Engrs.
Am. Inst. of Electrical Engrs.
Am. Inst. of Chemical Engrs.
Am. Association of Engineers
Am. Soc. for Engineering Education
Am. Soc. of Htg. & Ventilating Engrs.
Am. Soc. of Refrigeration Engrs.
Am. Water Works Association
Illuminating Engineering Soc.
Inst. of Aeronautical Science
Inst. of Radio Engrs.
National Soc. of Professional Engrs.
Soc. of Automotive Engrs.
Soc. of Naval Architects & Marine Engrs.

FROM THE NATION'S *Capital*

JOSEPH H. EHLERS, M. ASCE
Field Representative ASCE

MANY OF THE ASCE activities in Washington have been carried on in cooperation with the other Founder Societies. In this work Engineers Joint Council is playing its role as a cooperative, federating agency for the national societies representing the basic branches of the profession. Every member of ASCE can feel that he has an important personal interest in Engineers Joint Council in rendering service in the public interest through the engineering profession.

The ASCE Washington office cooperates closely with all EJC activities here by rendering staff assistance to EJC committees, on all of which ASCE is represented, as well as through designation of the Field Representative as one of the ASCE members of the EJC National Engineers Committee, which deals with governmental activities.

Point IV Program Becomes Law

The Point IV Program was enacted into law in June as Title IV of the Foreign Economic Assistance Act of 1950 (P.L. 535), this title being designated the "Act for International Development." The appropriations for this work, after being cut to less than $20,000,000, finally emerged from a Senate Committee at approximately the $35,000,000 authorized in the legislation. While not sufficient for an all-out program of aid to underdeveloped countries, it will enable the United States to fulfill its commitments to the United Nations program in addition to carrying on a strictly American program of sizable proportions. The part of the program providing for guarantees of private capital by the Export-Import Bank passed the House and is now on the Senate Calendar for action, after being reported out of the Senate Committee favorably in mid-July.

Engineers Joint Council should be able to play an important role in this and related international activities. It has recently been placed on the special register of non-governmental organizations of United Nations, giving it status as an advisory body to the UN. Meetings at Lake Success are regularly attended by the EJC representative, and the EJC representative on the U.S. National Commission of UNESCO is a member of its executive committee. Another representative attended the meeting earlier this year at which the draft constitution of the Union of International Engineering Organizations was adopted.

Survey of Manpower for Military Work

In connection with the increasing importance of military matters, it is interesting to note that prominent officials of the executive branch have attended recent EJC meetings to discuss the manpower problem and the interest of the engineering societies in seeing that engineers in defense and military work are placed in positions where their experience will be properly utilized. Questionnaires sent to 100,000 engineers by the EJC Committee on Selected Engineering Personnel are being used to compile a basic file of engineers. This work was initiated at the request of the Office of Naval Research.

Army Reorganization Bill Passed

The Army Organization Act of 1950 was signed by the President on June 28 and has become Public Law 581—81st Congress, 2nd Session. Both the House and the Senate versions contained amendments protecting the status of the engineer. The various technical services of the Army are more adequately protected than in the originally proposed version to which EJC took exception. Under the original version, any of the technical services could be consolidated or abolished at any time by the Secretary of the Army. In the law as finally passed, the Secretary of the Army may add new branches but may discontinue or consolidate any of them only "... for the duration of any war or national emergency hereafter declared by the Congress." The language suggested by Engineers Joint Council for the protection of professional engineers appears in the final bill unchanged and classifies these technical services among the other "learned professions." (see CIVIL ENGINEERING June 1950, page 51).

Science Board to Include Engineers

The National Science Foundation Act of 1950 has been previously mentioned as having been enacted into law (P.L. 507). (See June issue, page 55.) Engineers Joint Council has now submitted to the President a list of prominent engineers, skilled in the administration of research activities, as nominees for membership on the Board of 24. It is hoped that the number of engineers selected will be in reasonable proportion to the contribution that engineering is expected to make to the Foundation's work. It is believed that EJC efforts in having engineering included in this bill and in aiding in its enactment into legislation is one of the outstanding contributions to the public welfare contributed by the engineering profession acting as a unit through EJC on behalf of the 110,000 members of the constituent societies.

Engineers Advisory Committee to CSC Authorized

Nominations have been submitted by EJC to the Civil Service Commission for membership to represent the engineering profession on the Engineers Advisory Committee recently authorized by the Commission. In addition to assisting in the establishment of this official committee of the Civil Service Commission, the Engineers Joint Council Committee on Civil Service has taken up with the Commission some problems relating to the place of engineers on important inspection work including boiler inspection and the various positions established by the Commission on construction operations. The EJC Committee is endeavoring to secure a proper place for young engineers in training on inspection work as well as to insure that inspection work requiring the exercise of important engineering judgment will be performed by qualified engineers.

EJC Water Policy Statement Acclaimed

The comprehensive statement on National Water Policy recently submitted to the President's Water Policy Commission by the EJC Water Policy Panel is receiving widespread publicity and favorable comment in Washington. Requests for additional copies are being received daily from both the executive and legislative branches of Government, from the press, trade associations and individuals. It shows promise of becoming the most widely acclaimed document ever presented by the engineering profession speaking as a whole. That such a masterly document could be prepared in such a brief period of time is a commentary on the increasing unity of the profession and a tribute to those who were able to marshal the services of such an array of top talent as was drawn on here and direct it so successfully to a unified conclusion.

July 18, 1950

Postscript on Korea

The Korean situation is forcing us into a partial war economy. A partial mobilization of indefinite extent in time has been agreed upon rather than any full mobilization now. The general scheme is to have the National Security Resources Board remain strictly at the staff level, passing all operating functions on

to the executive departments in order to avoid the difficulty of the last war where WPB umpired its own operating conflicts. NSRB will serve as umpire between the conflicting demands for civilian and military needs. The Department of Commerce will direct any material controls and allocations. Presumably, the Labor Department will direct labor controls whenever they are needed. The President wants $10½ billion. Sentiment is strong for a pay-as-you-go operation as long as it can be held to a limited scale long in duration, for there are a dozen other potential "Koreas" around the world. General tax increases are to be expected.

H.R. 9176 and a companion bill in the Senate are the administration bills to provide the President with the powers he desires to divert materials and facilities from civilian to military purposes. It would give him authority to establish priorities and allocate materials. It would give him power to make and guarantee loans for increasing productive capacity for developing technological processes or for producing essential materials. It would give him wide powers to regulate both consumer and real estate credit. It would not permit rationing at the retail level of goods for household or personal use. Federal control would apply over state and state agencies.

It is thus seen that a firm control of the economy by government is proposed. Hearings on the bill are under way. There may be some substantial changes made in the bill, but some strong measure of control is certain to be granted. The hearings will develop some demands for more voluntary controls than the arbitrary controls the bill includes. The program will be directed strictly to military needs, including facilities such as machine tools. Construction of "war housing" and "community war public works" are not contemplated at present. Unquestionably there will be a diminution of non-essential civilian construction. The President has sent a letter to all department heads asking them to review all government construction programs with a view to curtailment, and to report them to the Director of the Budget.

It is expected that the rate of starting construction of new homes will be materially reduced before the end of the year. Other construction not yet started will have to be reviewed with reference to its military value. Public projects such as roads, schools, and slum clearance will be cut. Steel and other metals will be diverted from automobiles, building materials, and household appliances into military channels. Emphasis on Alaska and other strategic areas probably will find expression in liberal appropriations on the military construction appropriation bill coming up for action soon. Should the situation deteriorate much further, wage and price controls may be needed, although with an election in the offing, it is likely that some of the more unpopular requirements will be postponed.

Washington D.C.
July 24, 1950

Invitation to Society's Houston Convention

TEXAS SECTION PRESIDENT LOWBER D. SNOW (left), in Toronto for recent Summer Convention, extends invitation for 1951 Houston Convention to ASCE President Ernest E. Howard, EIC President John E. Armstrong, and E. Rost Graydon, chairman of Toronto Joint Convention Committee. General committee for Houston Convention, to be held February 21-23 under auspices of Texas Section, consists of Robert J. Cummins, chairman, Mason Lockwood, S. W. Oberg, and Mr. Snow.

Local Section Conference Scheduled for Chicago

EXCEPTIONALLY WIDE LOCAL Section representation is planned for the Conference of Sections to be held in Chicago in October at the time of the ASCE Meeting. At the invitation of the Board, one official delegate from each of the following Mid-Western and Northwestern Sections will attend the Conference: Akron, Central Ohio, Central Illinois, Cincinnati, Cleveland, Dayton, Duluth, Illinois, Indiana, Iowa, Kansas, Kansas City, Kentucky, Michigan, Mid-Missouri, Montana, Nebraska, Nashville, Northwestern, Oregon, St. Louis, Seattle, Spokane, Tacoma, Toledo, Tri-City, Wisconsin, and Wyoming. Others interested in Local Section affairs may also attend without official status.

The Montana, Oregon, Seattle, Spokane, and Tacoma Sections are being included in the Conference, because they would not otherwise have an opportunity to be represented at a Local Section Conference from July 1948 (at Seattle) to June 1952 (at Denver).

Back Copies of "Civil Engineering" Are Needed

DESPITE A GRATIFYING response to a request in the May issue for back copies of the October 1949 issue of CIVIL ENGINEERING, which is in short supply, copies are still needed to enable the Society to fill requests for bound volumes. Readers who have no further use for their copies of the issue will be performing a service by returning them to ASCE Headquarters.

Los Angeles Section Offers Seminar on Construction

CONSTRUCTION PRACTICES AND specification writing in the construction field are being reviewed for the convenience of engineers in the Los Angeles area in a series of weekly seminar meetings, sponsored by the Los Angeles Section of ASCE, in cooperation with local groups of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the Associated General Contractors.

Held at the California Institute of Technology, the seminars cover a wide field, ranging from proper techniques to use, selection, and productivity of standard and special construction equipment. Speakers are obtained from prominent Southern California industries.

ASCE Hydraulics Division to Have Jackson Meeting

As an outgrowth of the expressed desire of many hydraulic engineers to hold meetings separate from general Society meetings, the Board of Direction and the Division Activities Committee have approved the holding of a meeting of the Hydraulics Division in Jackson, Miss., November 1 through 3. The location was chosen to permit an inspection trip to the hydraulic laboratories of the U. S. Waterways Experiment Station at Vicksburg and Clinton, Miss., on November 3.

The general theme of the meeting will be "What's New in Hydraulics," with November 1 and 2 devoted largely to technical sessions in the field. An outstanding feature of the first day will be a Hydraulics Division banquet, at which Dr. Boris Bakhmeteff, Hon. M. ASCE, will be the principal speaker. Program details will be given in future issues of Civil Engineering. The Mid-South Section, which is host for the meeting, will hold its annual meeting in Jackson concurrently with the Hydraulics Division program.

Calling the Hydraulics Division meeting "a pioneer venture within the Society," Albert S. Fry, Division chairman, states that, "This type of meeting will be of interest as a pattern for future meetings of the Hydraulics Division and other divisions of the Society as well. It may well prove to be the answer to demand for more intense activity on the part of Society members within their respective divisions.

"Much real benefit can come from this new type of meeting. It will supplement the regular general meetings of the Society. But, above all, it will provide a forum for serious consideration and discussion of hydraulic problems within the framework of our existing Society on a more objective plane than now exists at the general Society meetings."

Scheduled ASCE Meetings

FALL MEETING
Chicago, Ill., October 11–13
(Board of Direction meets October 9–10)

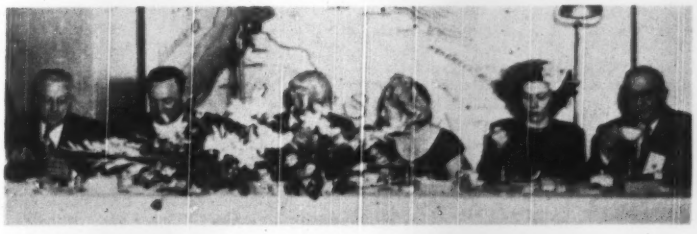
SPRING CONVENTION
Houston, Tex., February 21–23
(Board of Direction meets February 19–20)

SUMMER MEETING
Louisville, Ky., June 13–15
(Board of Direction meets June 11–12)

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Cleveland	May 26		Joint meeting with Case Institute of Technology Student Chapter. Stanley Macomber, president of Macomber Inc., Canton, Ohio, spoke on "Responsibilities of Engineers to Themselves." Student speakers included Anthony Lovsin, Paul Frank, and Kenneth Yarus.
Colorado	June 12	29	Dinner meeting with Director George W. Larab discussing Society affairs. Under the auspices of the Section's Structural Division, Walter Price, head, Materials Laboratory, Bureau of Reclamation, presented an illustrated lecture on "Some Factors Influencing the Strength of Concrete."
District of Columbia	June 3	...	Inspection tour of White House with Maj. Gen. Glen E. Edgerton, executive director, Commission on Renovation of White House, acting as guide.
Florida Gainesville Sub-Section	May 25	25	Outdoor steak broil at home of C. D. Williams.
Georgia	June 2	33	Problems connected with the growth of the City of Atlanta were discussed by Philip Hammer, director of the Metropolitan Planning Commission of Greater Atlanta.
Illinois	May 24	...	Juniors' annual smoker and dinner meeting, featuring George D. Gaw, of the Color Research Institute, as principal speaker.
Indiana	May 23	239	Annual joint meeting with Student Chapter members of University of Notre Dame, Purdue University, and Rose Polytechnic Institute.
Intermountain	May 26	...	Dinner meeting. Speakers included George South, president of Section; Russel Smith, member of Utah State Agricultural College Student Chapter; and Prof. O. W. Israelsen, of USAC.
Kansas City	May 24	58	Dinner meeting with Phillip Giessal, principal planning engineer, Kansas City Planning Commission, speaking on future developments.
Los Angeles	May 31	35	Junior Forum annual banquet. Robert H. Hadow, Consul-General of Great Britain for Los Angeles, described the political and social picture in England.
	June 27	170	Annual field day at Oakmont Country Club in Glendale.
Miami	May 31	13	Luncheon meeting. Inspection trip to Cape Florida on Key Biscayne was conducted by Milton B. Garris, of Miami, Fla.
Mid-Missouri	May 22	...	Dinner meeting. Norman Moore, chief, Engineering Division, Mississippi River Commission, spoke on engineering activities of commission. A sound film, "The Valley of the Giant," supplemented Mr. Moore's talk.
Mid-South Jackson Branch	May 26	16	ASCE Vice-President Robert B. Brooks was guest of honor at special dinner meeting.
	May 29	26	Regular dinner meeting. Bryant Mather, chief, Special Investigations Branch, Concrete Research Division, Waterways Experiment Station, Vicksburg, Miss., discussed new developments and current problems in concrete.
Mohawk Hudson	May 25	...	Dinner meeting sponsored by Section together with members of faculty and alumni body of Rensselaer Polytechnic Institute in honor of Warren C. Taylor, recently retired as professor of civil engineering at Union College. Professor Taylor was guest speaker. Other speakers included Edward W. Wendell, assistant chief engineer of State Department of Public Works; Harold V. Gulick, assistant chief engineer, American Locomotive Co.; Ralph Champagne, Troy, N.Y., city engineer; and Professors LeRoy W. Clark, A. A. K. Booth, and G. R. Shaw, all of RPI faculty.
Montana	April 14	...	Meeting for purpose of organizing Helena Branch of the Section.

	April 28		Business meeting with formation of committee to amend civil engineers' registration law. Alden Orr, head of economics & repayment section of U.S. Bureau of Reclamation, was guest speaker.
	May 4		Joint meeting with members of Montana State College Student Chapter. William Price, project engineer of Bureau of Reclamation's Canyon Ferry Dam project, described construction progress.
Providence	May 23	55	Annual dinner meeting. Presentation of life membership certificates. Speakers included ASCE Director Harold W. Blakeslee; Vice-President Albert Haertlein; Sydney Wilmot, manager of ASCE technical publications; and Dr. John G. Albright, head of physics department, Rhode Island State College.
Sacramento	May 16	105	D. C. Seeley, installation engineer of Bureau of Reclamation, Sacramento, Calif., gave a speech entitled, "The Tracy Pumping Plant."
	May 23	77	Meeting conducted by Junior Members of Section.
St. Louis	May 22	130	L. J. Sverdrup, Sverdrup & Parcel, St. Louis consultants, talked on the Bi-State Development Agency. Mr. Sverdrup is chairman of organization.
San Diego	May 23	30	Dinner meeting with B. Kenneth Goodman, counsel for Ryan Aeronautical Corp., as speaker.
Seattle	May 24	94	Business meeting with Edwin Strandberg, structural engineer, of Seattle, Wash., reporting on activities of Puget Sound Engineering Council.
Tennessee Valley			Spring meeting held in recently dedicated Perkins Hall Engineering Community Center, Knoxville. Dean N. W. Dougherty, of University of Tennessee, was speaker of evening. Reid A. Ellis, chief of Tennessee Valley Authority, Project Building Branch, spoke on two new hydroelectric projects of the agency—Boone and Fort Henry dams. George E. Schaetzel, deputy for operations of Arnold Engineering Design-ing Center, of Tullahoma, talked on plant installation.
Holston Sub-Section	May		Van Court Hare, on the staff of chief engineer of Tennessee Valley Authority, spoke on the "Middle East."
Knoxville Sub-Section	May		George E. Tomlinson, state director, Project Planning Branch, Bureau of Reclamation, gave a talk on the Bureau's construction program.
Muscle Shoals Sub-Section	May		Round-table discussion on public health was conducted with Fred W. Thomas, sanitary engineer of U.S. Public Health Service, acting as moderator.
Oak Ridge Sub-Section	May 16	10	Presentation of films on underground blasting and tunneling techniques.
Texas Austin Branch	May 22		Organization meeting with election of officers.



SPEAKERS' TABLE AT MID-SOUTH SECTION BANQUET, culminating feature of recent well-attended Spring Meeting in Little Rock, Ark., shows (left to right) Col. Roy D. Burdick, master of ceremonies; W. M. Shepherd, vice-president of Arkansas Power & Light Co., Little Rock, who spoke on "Industrial Progress in Arkansas"; Herbert S. Gladfelter, president of Mid-South Section; Mrs. Burdick; Miss Aileen Smith, of Arkansas State Highway Department; and ASCE Director Webster L. Benham, Oklahoma City, Okla. All-day technical program featured talks on Bull Shoals Dam by Don Basgen, construction engineer, and L. F. Sherman, assistant resident engineer, Corps of Engineers; secondary road problems by G. A. Wilkins, Bureau of Public Roads; and methods of financing municipal improvements by Max Mehlburger, consulting engineer. Recently organized Little Rock Branch of Section served as host to meeting, which was marked by attendance of many younger members and students.

STUDENT CHAPTER

CLEMSON COLLEGE

Sam L. Pettit, outstanding civil engineering student at Clemson College, received the ASCE award of Junior membership, at the recent annual Scholarship Recognition Day exercises in Tillman Hall.

COOPER UNION

"The Professional and Personal Relations of Engineers" was discussed by Henry T. Perez, editor of *Construction Methods and Equipment*, at a recent dinner meeting of the Cooper Union Student Chapter. William Goldsmith, president of the Cooper Union Alumni Association, presented first prize in the student paper competition to Paul Parisi for his paper on prestressed concrete. Other prize winners are Gerhart King, who spoke on the use of concrete in sea water construction, and Marvin Siegel, who discussed "The Norris Dam and TVA."

PICTURED AT RECENT DINNER MEETING of Cooper Union Student Chapter are, left to right, Emmet Covello, master of ceremonies; Dr. Edwin Burdell, director of Cooper Union; Marvin Siegel, receiving award for his contribution in student paper contest; and William Goldsmith, president of Cooper Union Alumni Association, making presentation.

UNIVERSITY OF COLORADO

Speakers at recent meetings of the University of Colorado Student Chapter include Tom Blair, chief engineer of the Sante Fe Railroad; Frank H. Prouty, chairman of the Colorado State Board of Engineering Registration; and Bob Davis and Tom Cummings, both on the staff of the U. S. Geological Survey, at Denver. Newly elected officers of the Student Chapter are President Jim Hillock, Vice-President Gene Goley, Secretary George Marshall, and Treasurer John Houston.

NEWS BRIEFS

Soil Testing and Metals Research Featured on ASTM Technical Program

NEW INTERPRETATIONS OF triaxial test data and applications of these data were described in papers comprising two important technical sessions during the 53rd annual meeting of the American Society for Testing Materials in Atlantic City, N. J., June 26-30. Presented under the auspices of the ASTM Committee D-18 on Soils, the symposiums included discussion of application of the tests to highway materials, including asphaltic and subgrade mixtures, as well as adaptation to flexible bases and foundations. Sessions on identification and classification of soils were also featured.

L. J. Markwardt

The technical program also emphasized the metals field. There were symposiums on the use of metals at elevated temperatures, on corrosion and erosion of gas turbine materials, and on the effect of sigma phase on the high-temperature properties of metals.

Recommendations from technical committees resulted in 68 new specifications and tests, with revisions in some 200 existing standards and tentatives. All will be published later, and they will also be included in the 1950 Supplement to the 1949 Book of ASTM Standards.

The biennial exhibit of testing apparatus and related equipment, together with a photographic exhibit featuring prints, photomicrographs, and electron micrographs on engineering materials, were popular features of the four-day program. The registered attendance of 2,134 established a record.

L. J. Markwardt, M. ASCE, assistant director of the U.S. Forest Products Laboratory, Madison, Wis., was elected president of the organization for 1950-1951; and Truman S. Fuller, engineer for the General Electric Co., Schenectady, N.Y., new vice president. F. E. Richart, M. ASCE, research professor of engineering materials at the University of Illinois, will serve the second year of a two-year term.

AGC Group Forecasts Record Construction Year and Keen Competition in Contracting Field

WHILE CARRYING OUT the largest volume of construction in peacetime history, the general contracting industry continues to face strong competition in the construction of many engineering projects, in the opinion of the Associated General Contractors of America.

Reporting a mid-year survey of its member organizations throughout the country and Alaska, the AGC states that a volume of new construction in excess of $22 billion is expected for 1950, and that the total volume of construction, including maintenance and repair operations, will probably be more than $30 billion. Only highway construction is reported lagging due to the failure of some states to finance their construction programs and to the fact that other states have exhausted their federal-aid funds. The reporting groups represent more than 5,500 firms, which perform an estimated 80 percent of the nation's contract construction.

Predicting that construction will continue at a high level during the remainder of 1950, the contractors report that the tremendous volume of construction being carried on has caused shortages of manpower and materials in a number of communities. More than half the groups surveyed claim shortages of steel, cement, lumber, brick, and gypsum, while another 20 percent report insufficient supplies of such items as wall board, plywood, plumbing piping, soil pipe and fittings, concrete block, and roofing materials. Wage rates and prices of materials are found to have increased in recent months.

Competition was characterized as strong by 97 percent of the groups. One effect of this competition, they state, is that construction costs to owners are held down while prices to general contractors have increased. Although some price increases to owners are expected on projects to be awarded, no major increases in construction costs for the larger types of projects are looked for.

Governors' Conference Adopts Highway Program

ACTION TAKEN BY the state governors at their recent annual conference in White Sulphur Springs, Va., in assuming leadership in the program for safer highway transportation is hailed by the Automotive Safety Foundation in a recent issue of its *Bulletin*. The state executives adopted by resolution a report of the Council of State Governments calling for the development of adequate highways; reduction of traffic accidents; enactment of uniform motor vehicle laws; and formulation of sound highway fiscal policies.

The resolution urges the governors to seek appropriate legislative action in 1951, when 44 of the state assemblies will be in session, and suggests immediate appointment of an individual or board in every state to work out detailed plans for implementing the program.

Kentucky Initiates Water Pollution Control Program

AN ACCELERATED CAMPAIGN to clean up Kentucky streams was initiated on June 20 when state legislation establishing a pollution-control commission went into effect. The new law is an outgrowth of Kentucky's participation in the eight-state Ohio River Valley Water Sanitation Compact to promote basin-wide control of existing and future pollution. (See article by Edward J. Cleary in this issue.)

The six-man commission is empowered to establish quality standards for waters in the state according to their uses and to issue orders for the abatement of waste discharges or adoption of remedial measures to curb pollution. A permit must be obtained from the commission before any wastes can be discharged into the waters of the state, or before new outlets for waste discharge or changes in an existing system of disposal can be made. Penalties for violation include heavy fines and imprisonment.

F. Clarke Dugan, M. ASCE, director of the division of sanitary engineering of the Kentucky State Health Department, is technical secretary and administrative agent of the commission.

Large Stripping Plant Built by Gas Transmission Company

CONSTRUCTION OF A $12,000,000 plant for the extraction and recovery of liquid hydrocarbons from natural gas has been started near Greensburg, Ky., for the Tennessee Gas Transmission Co., according to an announcement from the headquarters of the organization in Houston, Tex. Located adjacent to the company's natural gas pipeline, wich runs from Texas to the Eastern states, the plant will process a considerable part of the natural gas passing through the system at that point. The Stone & Webster Engineering Corp. holds the construction contract for the project, which is scheduled for completion by the summer of 1951.

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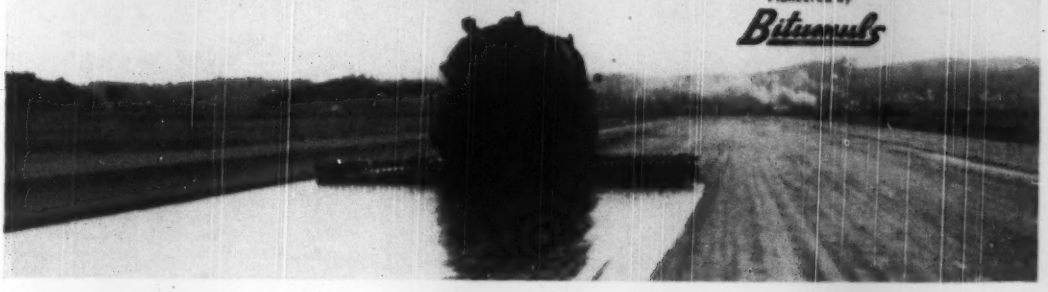


QUIZ for Paving Engineers

How do YOU answer these questions?

1. **Can you hold wet, round gravel or large aggregate with your present binder?**
2. **Does your binder stay on the road, when "shooting" a steep grade or high crown?**
3. **Are your surface treatments rugged, non-skid, and vapor-permeable?**

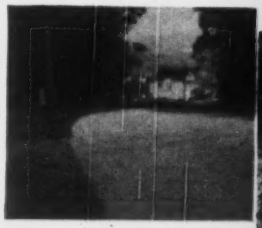
If your answer to all three questions is "Yes", you must be using *Bitumuls HV*—a "High Viscosity" asphaltic emulsion that is now used by a majority of State Highway engineers, because it really holds the aggregate, large or small, wet or dry.

Precise application is easy. No excess binder to cause fatness or slippery pavements—or to act as a vapor barrier retarding drainage by upward evaporation. You get a non-skid, vapor-permeable seal.

If You have not used "HV", try it on one job—you, too, will adopt it.

1. Stone Held?

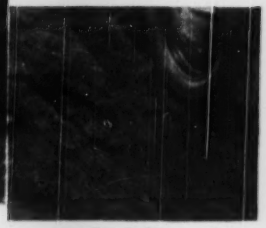
—or Ravels?



2. Binder stays put?

—or Runs Off?

3. Rugged & Non-skid?



—or Fat & Slippery?

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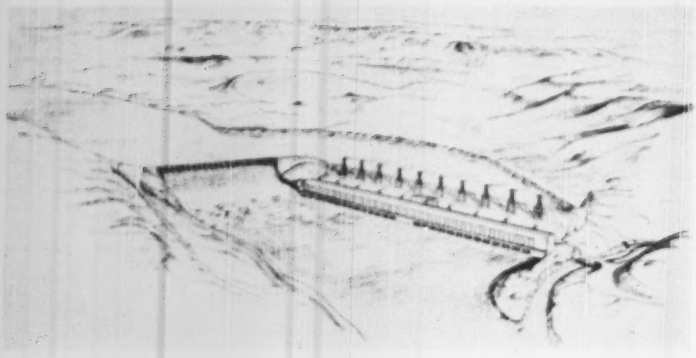
- Hydrapel—Admix for concrete . . . ☐
- Tennis Courts—Laykold & Grasstex . ☐
- Fibrecoat—roof and metal coating . ☐

Construction Starts on Chief Joseph Dam Project



FIRST-STAGE CONSTRUCTION OF $206,000,000 Chief Joseph Dam project, located on Columbia River near Bridgeport, Wash., gets under way with award of initial Corps of Engineers contracts. On June 27 Peter Kiewit Sons' Co., of Los Angeles, received $1,000,000 contract for first construction work, including cofferdam, right-bank blanket, and excavation. Contract for construction of ten 100,000-hp turbines (shown in right foreground) is held by Newport News Shipbuilding & Drydock Co., Newport News, Va. Excavation of powerhouse intake channel and relocation of state highway are proceeding under $2,265,000 contract held by General Construction Co., of Seattle. Chief Joseph Dam is being built by Seattle District of Corps of Engineers, which is headed by Col. Emerson C. Itschner, M. ASCE, as district engineer. Completion is scheduled for 1957 or 1958.

Government Predicts Record Outlays for New Construction

NEW CONSTRUCTION THIS YEAR will probably amount to almost $26 billion, according to revised estimates of the Construction Division of the Department of Commerce and the U. S. Labor Department's Bureau of Labor Statistics. Predictions for this unprecedented volume of new construction are based on record breaking construction activity during the first half of 1950 and indications that the last half of the year will see a continuation in the present building boom. Predictions assume that there will be no significant change in the international situation.

The $26 billion estimate for 1950 is 14 percent above the revised estimate of $22.6 billion spent for new construction in 1949. During the first six months of the year, expenditures for all types of new construction were 17 percent above the corresponding period in 1949. However, a seasonal downtrend in construction activity is expected in the late fall and winter, in contrast to last year's contra-seasonal increase, particularly in home building.

It is expected that private outlays for construction of new dwellings in 1950 will total about $10 billion, compared with $7.3 billion last year. Expenditures for public housing will be slightly greater than last year. Indications are that close to 1,250,000 new dwellings (including about 50,000 public housing units) will be started this year, surpassing by far the 1949 record of 1,026,000 and the previous high of 937,000 units in 1925.

The joint government agencies report expansion in recent months in construction of stores and other retail establishments, and a turn upward in industrial construction after a three-year decline. Public utility construction is said to be declining slightly, especially communication facilities, and outlays for farm construction are at a lower rate than last year. Expenditures for hospitals, schools, and reclamation and flood control projects are reported substantially higher than last year, but highway construction is at about the same level.

Stating that the high level of construction activity has brought pressure on supplies of materials and skilled labor, the two departments point out that increased production of materials and skilled craftsmen, made available through apprentice training programs, should prevent serious over-all supply difficulties such as those experienced immediately after the war.

Papers Sought for International Hydraulics Meeting

ENGINEERS INTERESTED IN hydraulics are reminded that papers are still being received for the next meeting of the International Association for Hydraulic Research, to be held in Bombay, India, January 3-5, 1951. Papers for presentation at the meeting should contain new ideas, based either on experimental objectives or theoretical studies. They should be sent in quadruplicate to the president of the IAHR—Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis 14, Minn.—who will preside at the Bombay meeting.

The subject matter should lie within the scope of the following: (1) Design of lined canals; (2) headworks to exclude solid materials from canals; (3) effect of barrages and dams on the regime of rivers; and (4) distribution and control of water and solids in canals.

Inquiries about the meeting will be welcomed by Dr. Straub or by the chairman of the Indian Committee on Arrangements, S. L. Malhotra of Simla, India. Immediately preceding the meeting, there will be three other international engineering conferences in India—the World Power Conference, the International Commission on Large Dams, and the International Commission on Irrigation and Canals. Also of interest to the visiting engineers will be an Indian International Engineering Exhibition, to be held in New Delhi concurrently with the meetings of IAHR and the other international engineering associations.

New Jersey Announces Large Turnpike Awards

TWO MAJOR CONTRACTS for construction of the 118-mile New Jersey Turnpike in Union, Burlington, and Mercer counties have just been awarded by the New Jersey Turnpike Authority, according to an announcement from Chairman Paul L. Troast.

Contract No. 31, amounting to $2,375,781, has been let to the Grow Construction Co., Inc., of New York City. It involves the construction of substructures for fourteen bridges, an abutment, grading and drainage, and other incidental work in Elizabeth. Contract No. 37, awarded to the Conduit & Foundation Corp., of Philadelphia, for $2,129,445.50, calls for the construction of eleven steel and reinforced concrete bridges, grading and drainage, and paving between Moorestown and Allentown.

California Contractors to Build Nebraska Dam Project

AWARD OF A $4,726,557 contract for completion of Trenton Dam on the Republican River in southwestern Nebraska has just been made to three Southern California contractors, according to a Department of the Interior release. The successful joint bidders are the Vinnell Co., Inc., of Alhambra; Ralph A. Bell, of Monrovia; and the United Concrete Pipe Corp., of Baldwin Park.

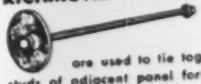
Construction of the dam, which will be a mile and a half long and 145 ft high, is to begin by the middle of August and be completed within three years. Work will be under the Bureau of Reclamation. When finished, the project will serve as one of the principal water conservation structures in the Frenchman-Cambridge division of the Missouri River Basin Program.

ENGINEERED TYING DEVICES, ANCHORAGES and ACCESSORIES for CONCRETE CONSTRUCTION

RICHMOND GIVES YOU EXACTLY THE RIGHT ANSWER TO EVERY FORM-TIEING REQUIREMENT

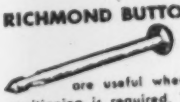
Richmond has perfected dozens of devices to meet specific needs in concrete form work. Here are three products which have been found to be useful on most jobs.

RICHMOND PANEL-TYS

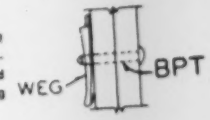


are used to tie together the end-studs of adjacent panel forms. There is a head washer at each end, with a large loose-fitting washer at one end. The Ty-holder engages at the other.

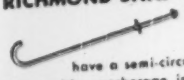
RICHMOND BUTTON HEAD PANEL-TYS



are useful when the most exact positioning is required. The design eliminates side slippage. The end is notched for the Tyholder. Also useful for tieing in ledgers.



RICHMOND SNAP-TYS ANCHORS



have a semi-circular hook providing positive anchorage in concrete. These are 1" break back type with a flat guide washer to guage correct position for anchoring sill blocks for construction bracing.

HOW COME WE'RE GETTIN' SO MANY JOBS LATELY ?
THE BOSS SAYS RICHMOND HELPS HIM DO A BETTER JOB IN LESS TIME AND FOR LESS DOUGH !
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Slight Gain in 1949 Steel Exports Reported

EXPORTS OF IRON and steel products in 1949 came to 4,685,462 tons, a slight gain over exports in 1948, but the second lowest in the past decade, according to compilations by the American Iron and Steel Institute from Department of Commerce reports.

Despite the comparatively small shipments of iron and steel to foreign countries last year (only slightly more than 8 percent of total shipments), total steel pipe exports established a record of 834,183 tons. The total exceeded the 1948 tonnage by 38 percent and was 22 percent greater than in 1947, the previous top year for pipe exports. Tonnage records were set in exports of both seamless and welded casing and oil-line pipe and welded galvanized pipe.

Mechanical Engineers Choose Officers for 1951

J. CALVIN BROWN, owner of the Los Angeles, Calif., firm bearing his name has been nominated 1951 president of the American Society of Mechanical Engineers. Mr. Brown heads a slate of new officers that includes four regional vice presidents and two directors-at-large. The vice presidents are Henry R. Kessler, New York; Stephen D. Moxley, Birmingham, Ala.; John T. Rettaliata, Chicago; and Carl J. Eckhardt, Austin, Tex. Nominated as directors are Lionel J. Cucullu, New Orleans, and Harold E. Martin, New York. Since only one name is presented for each office, nomination is tantamount to election.

Lake Mead Study Shows Small Reduction in Capacity

RESULTS OBTAINED IN the recently completed sedimentation survey of Lake Mead show that more than two billion tons of silt have been deposited in it since 1935, according to a recent release of the U.S. Geological Survey, which conducted the studies for the Bureau of Reclamation with the help of equipment, personnel, and special techniques of the Navy Department.

Pointing to the fact that this material now occupies about 5 percent of the reservoir storage capacity below the spillway level (1205.4 ft), Survey officials predict that silt will completely fill the reservoir in 425 years, (445 years from completion of dam), if the present rate of sedimentation continues. However, construction of upstream erosion dams to arrest soil movement would prolong the life of the lake almost indefinitely, they state. Other suggestions are for construction of gated dams near the head of the lake, which in connection with tunnels acting as siphons, would permit shunting the heaviest silt-laden waters around the lake and directly through the powerhouse sluiceways.

The survey is based on studies of approximately 1,600 cross sections of sedimentary layers obtained by core techniques. In this work a long hollow tube about 2 in. in diameter, lined with plastic to permit easy handling of the contents, is plunged into the mud. Some cores as long as 90 ft were obtained. A study of the water circulation in the lake, made by the Physical Oceanography Group of the U.S. Navy Electronics Laboratory, was a vital part of the work. The water quality of the lake water and its feeder streams was determined by USGS limnologists. Survey data may be studied in USGS offices in Washington, D.C., or Tucson, Ariz.

Army Engineers Begin Work on Kansas Flood Control Project

CONSTRUCTION WAS RECENTLY started on the $16,250,000 Wichita and Valley Center (Kans.) Flood Control Project under direction of the Tulsa District of the Corps of Engineers, according to an announcement from C. W. Schofield, Assoc. M. ASCE, engineer in charge for the city and county. Col. Edward Daly, district engineer, heads the work for the Corps. Engineering for the project is under the direction of F. C. Kendall, chief of the engineering division of the Tulsa District, and John W. Soderberg is resident engineer on construction.

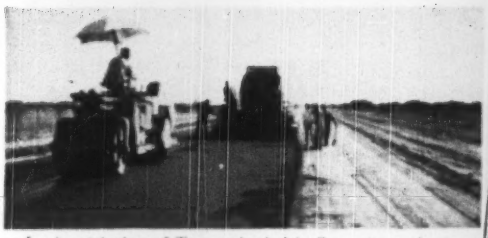
In the planning stage for the past five years, the project for the protection of Wichita and its environs will be built with $10,730,000 in federal funds and other non-federal funds. An unusual feature of the project is the fact that the City of Wichita will obtain complete protection from floods without the necessity of building flood walls or doing channel improvement work within its corporate limits. The use of expensive pumping installations to take care of interior drainage is also eliminated.

Plans call for the diversion of floodwaters around the city into the existing Wichita Drainage Canal, which is being cleaned and rectified, and for the construction of floodways to handle flows from Chisholm Creek and the Arkansas and Little Arkansas rivers. Construction of five new highway bridges and four new railroad bridges will be involved in the work.

The Bassett Construction Co., of Wichita, holds the contract for the first portion of the main floodway, and the Sherwood Construction Co., Inc., the contract for channel rectification work on the Wichita Drainage Canal. Contracts for the rest of the work will be let at six-month intervals, with total construction time estimated at two years.

Hydraulic Model Displayed at Dedication of Reclamation Engineering Center

DEDICATION OF RECLAMATION ENGINEERING CENTER at Denver, on July 20 and 21, includes exhibition of facilities Bureau of Reclamation uses in its design and construction work. Numerous hydraulic models in operation include that of Anchor Dam, pictured here. On full-size structure, which will be feature of Missouri River Basin Project in Wyoming, water falls 91 ft from spillway crest to ski-jump bucket below, and is then deflected 150 ft downstream before falling to river surface. W. P. Simmons, Jr., hydraulic engineer, is shown determining depth of water on spillway face.



Laying 4 inches of Texaco Asphaltic Concrete paving, containing low-cost local aggregate, on State Highway 29 in Texas.

Applying a hot seal coat of 175-penetration Texaco Asphalt to the asphaltic concrete surface.

Crushed gravel, heated to 375°F. is spread and rolled into the asphalt seal coat.

Completed Texaco Asphalt pavement on 12 miles of Texas Route 29, constructed by J. M. Dellinger, Inc., of Corpus Christi.

Road-building with Texaco in aggregate-poor areas

Along the Gulf Coast of Texas, the only local aggregate for highways is caliche, a relatively soft material, and sand. How these low-cost materials were used to construct 12 miles of state highway will interest road builders in other aggregate-poor areas.

For a sub-base, caliche was laid to a compacted thickness of 7 inches. Over this was constructed 4 inches of Texaco Asphaltic Concrete—caliche and sand plant-mixed with a 90-penetration asphalt. To compensate for the soft caliche, a seal coat of 175-penetration Texaco Asphalt was applied and covered with heated, crushed gravel, the only imported aggregate used.

The caliche sub-base was primed with Texaco MC-1 Cutback Asphalt. Tack coats of Texaco RC-2 Cutback Asphalt were applied between the three or four layers of asphaltic concrete.

Whatever your own road, street or airport paving problem, you will find an effective, economical solution in Texaco's complete range of Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils. Refined from selected crudes, Texaco Asphalt products have helped construct and maintain America's highways for 45 years.

Two helpful booklets on asphalt construction may be secured by writing our nearest office.

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New York City Taps Hudson River Water

INTAKE CRIB, through which 100 mgd of Hudson River water can be fed into New York City supply system, is lowered into place atop piles on river bottom by huge floating derrick. Projection on right side of crib a 72-in. joint of intake, which will hook into underwater reinforced concrete conduit leading to pumping plant ashore. From there water will be pumped into Rondout-West Branch tunnel of Delaware Aqueduct. Scheduled for completion late this year, emergency pumping plant is being built by New York City Board of Water Supply on east side of river near Chelsea, N. Y. Contractors are Tuller Construction Co. and A. J. Dillenbeck, both of Red Bank, N. J.

National Applied Mechanics Congress to Be in Chicago

PLANS HAVE NOW been made to hold National Congresses of Applied Mechanics every four years, between the International Congresses, with the first scheduled for June 11-16, 1951, in Chicago, Ill., according to an announcement from the U. S. National Committee on Theoretical and Applied Mechanics. Other sponsoring organizations include, ASCE, ASME, AIChE, the American Mathematical Society, the American Physical Society, the Institute of Aeronautical Sciences, and the Society for Experimental Stress Analysis. Also cooperating are several universities in the Chicago area, including Illinois Institute of Technology which will be host to the Congress.

All workers in the field are invited to submit papers of 5,000 words or less, reporting original research in kinematics, dynamics, vibrations, waves, mechanical properties of materials and failure, stress analysis, elasticity, plasticity, fluid mechanics, and thermodynamics. To be considered for presentation at the Congress, complete papers or representative abstracts must be submitted to the chairman of the Editorial Committee—Eli Sternberg, Illinois Institute of Technology, Technology Center, Chicago 16, Ill.—before April 14, 1951.

Inquiries regarding the Congress, which is intended to supplement the International Congresses, may be addressed to the Secretary, N. M. Newmark, University of Illinois, Urbana, Ill. The next International Congress will be held in 1952 in Istanbul.

Role of Sanitary Engineer Lauded at Recent Meeting

THE INCREASINGLY IMPORTANT role of the sanitary engineer in such fields as civil defense, accident prevention, protection against plane-borne disease, and the numerous problems resulting from the expanding use of atomic energy was accented at the recent 30th annual meeting of the Conference of State Sanitary Engineers in Washington, D.C.

W. Palmer Dearing, acting Surgeon General of the U. S. Public Health Service, stressed the fact that environmental sanitation is no longer confined to water treatment and disposal of wastes. In "today's wider areas of concern," he listed control of air pollution, a healthful environment in the home, school, office, and factory, and "an awareness of the significance of atomic research in its relation to health." The new role of the sanitary engineer in civil defense planning, made imperative by discovery of the atomic bomb, was discussed by C. W. Klassen, chief of the Sanitary Engineering Division of the Illinois State Department of Public Health.

Restriction of federal activities in the field of pollution control to broad national problems was advocated by B. A. Poole, M. ASCE, director of the Indiana Bureau of Sanitary Engineering. In another paper, L. M. Fisher, engineering field associate of the American Public Health Association, said that the sanitary engineer can play an important part in preventing "upwards of 100,000 accidental deaths and millions of disabilities in the home each year through the application of engineering techniques, skills, and practices."

C. M. Everts, Jr., Assoc. M. ASCE, director of the Oregon Division of Environmental Sanitation, was elected new chairman of the conference, and Earl Devendorf, Assoc. M. ASCE, director of the New York State Division of Sanitation, vice-chairman. C. H. Atkins, chief of the Division of Sanitation of the Public Health Service, will continue as secretary-treasurer.

Attendance at the three-day meeting included public health officials from 45 states, Canada, Alaska, and Hawaii.

Albuquerque Officials Act on Traffic Survey Suggestions

PROMPT ACTION ON recommendations of the all-inclusive highway transportation survey recently completed in Albuquerque, N. Mex., is being taken by the city and the New Mexico State Highway Department, according to a release from the Automotive Safety Foundation. Members of the ASF staff directed the seven-phase traffic study authorized by the city last year in an effort to solve both its immediate and long-range traffic problems. Other cooperating organizations were the state and the Bureau of Public Roads. The population of Albuquerque has tripled in the past ten years—a rate of growth too rapid to obtain the facilities normally needed by a city of 100,000.

Radiant Heating System Is Installed in Texas Hangar

TO KEEP PERSONNEL COMFORTABLE and maintain airplane engines at room temperature for quick and easy starting, Pioneer Air Lines is installing more than three-quarters of acre of radiant heating in floor of large hangar, now nearing completion at Love Field, Dallas, Tex. Hot water will be circulated through piping system, portion of which is shown here, after embedment of wrought-iron pipe in the concrete floor. Hangar was designed by Dallas architectural firm of Buford & Feinberg, and consulting engineer is Herman Blum, of Dallas.

Lower pumping costs for water system near Dallas

One of the reasons Powell and Powell, Consulting Engineers for the Dallas County Parks Cities Water System, specified the Horton elevated tank shown above was because it has a radial-cone bottom design. This design—an *exclusive, patented feature*—reduces pumping costs because it provides a low range in head. The plates of the conical sections between the radial girders supporting the bottom are dished to a relatively long radius. This places them in tension and they carry the weight of the water in the tank without any other support. As a result, radial-cone tanks can be built with a larger diameter and a shallower depth more economically than can tanks *of other designs of the same capacity*. Costs for power go down since the pumps operate against a lower average head.

The Dallas County Parks System is not connected to the City of Dallas, Texas mains except on an emergency standby basis.

This 2,000,000-gal. tank is located in District Number 2 which provides service for the communities of University Park and Highland Park. There are 10,265 water system customers in these two suburbs. The average daily water consumption is 5.2 MGD.

• • •

Horton radial-cone bottom tanks are available in standard capacities from 500,000 to 3,000,000 gallons. For communities that require a smaller capacity tank, we furnish the ellipsoidal-bottom design in standard capacities from 15,000 to 500,000 gallons. When making plans for waterworks improvements write for estimating figures.

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Atlanta 3	2167 Healey Bldg.	Detroit 26	1541 Lafayette Bldg.	Philadelphia 3	1652—1700 Walnut St. Bldg.
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Boston 10	1009—201 Devonshire St.	Houston 2	2128 National Standard Bldg.	San Francisco 4	1584—200 Bush St.
Chicago 4	2199 McCormick Bldg.	Los Angeles 17	1556 General Petroleum Bldg.	Seattle 1	1309 Henry Bldg.
Cleveland 15	2263 Guildhall Bldg.	New York 6	3395—165 Broadway Bldg.	Tulsa 3	1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

Strong Demand for Engineering Graduates Reported at ASEE Annual Meeting

FOUR OUT OF five engineers graduating this June, in the largest class in the history of engineering education, accepted jobs or received job offers within three weeks of their commencement, M. M. Boring, chairman of the Manpower Survey Committee of the Engineers Joint Council, told engineers and educators attending the recent annual meeting of the American Society for Engineering Education at the University of Washington. Observing that "our country can still absorb a very large number of engineering graduates," Mr. Boring added, "There is much evidence that if we have a small enrollment in the freshman classes entering from high schools this fall, we will very clearly face a serious shortage of engineering graduates four years from now."

Mr. Boring's report was based on a survey of 117 engineering colleges throughout the country conducted by the Manpower Committee of the American Society for Engineering Education, under the chairmanship of Dean L. M. K. Boelter, of the University of California at Los Angeles. According to the survey, 62.5 percent of all engineering graduates this year were placed by June 15 and an estimated 20 percent more had received job offers without making any commitments.

Deploring recent publicity "regarding the possibility of an oversupply of engineering graduates," Mr. Boring emphasized the fact that the anticipated shortage of jobs for engineering graduates has not materialized. Especially during the past month, placement officers have reported a sharp upturn in the demand for graduating engineers. "It is now assured," he said, "that the number of engineering graduates placed this year will be the highest in the nation's history."

During the meeting Rolf Eliassen, Assoc. M. ASCE, professor of sanitary engineering at Massachusetts Institute of Technology, received the $1,000 George Westinghouse Award for "outstanding engineering teaching," and Harry P. Hammond, M. ASCE, dean of engineering at Pennsylvania State College, was recipient of the James H. McGraw Award of $500 for "distinguished contributions to technical institute education."

Four other engineering educators were elected new officers of the ASEE. They are Dean F. M. Dawson, M. ASCE, State University of Iowa, president; Dr. Gerald A. Rosselot, Georgia Institute of Technology, and Prof. Linton E. Grinter, M. ASCE, Illinois Institute of Technology, vice-presidents; and Charles L. Skelley, MacMillan Co., treasurer.

R. Robinson Rowe, M. ASCE

"THE WESCIR Chamber of Commerce," said Professor Neare, "nearly spoiled our problem by denouncing the census enumerators who found only 14,282 of their probable 20,000 inhabitants, but the count still stands, so, Joe, how many were Irish?"

"Thanks for the compliment, Professor, but with six equations, six unknowns and fifth powers, you didn't really expect much of me, did you?"

"I said there was an easy way, Joe."

"He meant synthesis by quanta," explained Ken Bridgewater. "In normal sequence the equations are:

$$\begin{aligned} x + y + z &= 7,117 \\ ax + by + cz &= 7,606 \\ a^2x + b^2y + c^2z &= 8,564 \\ a^3x + b^3y + c^3z &= 9,976 \\ a^4x + b^4y + c^4z &= 11,864 \\ a^5x + b^5y + c^5z &= 14,282 \end{aligned} \quad (1)$$

"Now, since people are quanta, each of the algebraic terms is an integer and the fifth powers in the last equation must be chosen from 1, 32, 243, 1,024, 3,125 and 7,776, divided possibly by fifth powers contained in x, y and z. If we had set up the equations in reversed sequence, the first equation would have similarly involved fifth powers up to 3,125. Using just these two equations and very few trials, I found

$$3,125 + 2 \cdot 1024 + 8 \cdot 243 = 7,117$$
$$7,776 + 2 \cdot 3125 + 8 \cdot 32 = 14,282$$

so that $a = 6/5$, $b = 5/4$, $c = 2/3$ and Irish = 7,776."

"I don't think the hard way is too hard," said Cal Klater. "If the six populations are represented by $P_n (n = 1, 2 \ldots 6)$ and we define three parameters:

$$u = abc, \; v = ab + bc + ca,$$
$$\text{and } w = a + b + c, \quad (2)$$

we can deduce generally:

$$uP_n - vP_{n+1} + wP_{n+2} - P_{n+3} \quad (3)$$

Particularly we will have three linear equations in u, v and w, which are easily solved and substituted in (2) and reduced to a cubic in one unknown, viz

$$\begin{aligned} 7,117u - 7,606v + 8,564w &= 9,976 \\ 7,606u - 8,564v + 9,976w &= 11,864 \\ 8,564u - 9,976v + 11,864w &= 14,282 \end{aligned}$$

$$u = 1; \; v = 47/15; \; w = 187/60$$

$$\frac{47}{15} = a(b+c) + bc = a\left(\frac{187}{60} - a\right) + \frac{1}{a}$$

$$60a^3 - 187a^2 + 188a - 60 = 0$$

$$(3a-2)(5a-6)(4a-5) = 0 \quad (4)$$

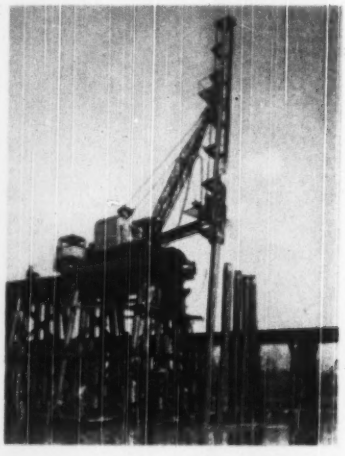
Since a, b and c are interchangeable in (1) and (2), the three roots of (4) are Ken's set for a, b and c and there is only one solution, not three. Substituting in the first three equations of (1) will give a linear set in x, y and z."

"Nice algebra, Cal, and the way it has to be done if the data are random. For those who dislike algebra, Professor Dolite has contrived an intriguer for next time. Theo?"

"All ready, Noah. It's one I ran into when I laid out Crescent Drive thru Corona Park. The circular park was divided into crescent and gibbous lunes by the long circular alignment of the drive, which also had to pass thru street intersections A and B outside the park. As it happened, A and B were 1,300 ft apart and distant 1,400 and 1,500 ft, respectively, from the center of the 1,600-ft-dia park, but my transitman located the drive without computation. Can you?"

[The Cals, Charles G. Edson and Ed C. Holt, Jr., were outnumbered by Kens Elisabeth F. Gittings, Julian Hinds, Richard Jenney, John L. (Stoop) Nagle, William E. Wilbur (who found the Irish outnumbered in 2004), John H. Wells, R. E. Phillco, and E. P. Goodrich. Guest Professor Thea Dolite is Ray S. Samuelson.]

Special Machinery Speeds Trestle Construction



TO HASTEN CONSTRUCTION of numerous trestle bridges required in Chicago, Burlington & Quincy Railroad's cut-off program in northwestern Missouri, John P. Abramson Construction Co., Des Moines, Iowa, which has contract for construction of four bridges between Forker Junction and Tina Junction, uses Lorain Moto-Crane equipped with No. 2 Vulcan steam hammer and pile driver leads built especially for job. Special swivel mounting of leads on crane boom head permits swinging them to either side of center line of boom, and support at base of leads permits their use in any position in driving batter piles. Moto-Crane moves forward on trestle as work requires on "A-acks" made of channels fastened to trestle floor to prevent possible side skidding of machine on the slippery, creosoted planking. C. B. & Q. cut-off program will reduce mileage between Chicago and Kansas City.

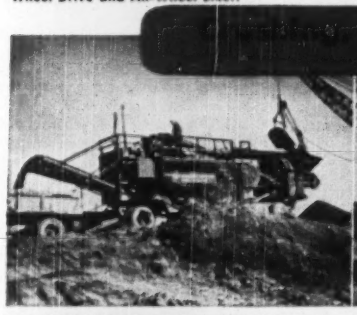
BUILT TO OUTPERFORM

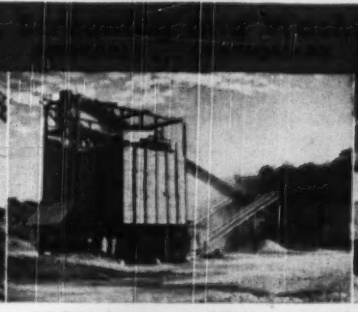
The Power Graders That Have Everything

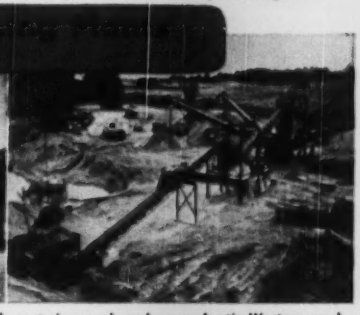
"88-H"—a new model of medium size with all the extra traction and maneuverability of All-Wheel Drive and All-Wheel Steer.

"99-H"—popular with contractors and highway departments for its all around performance, under all conditions, in all seasons.

MASTER "99"—combining the best features of the "99-H" with the extra power, traction and road speed of its 100 horsepower engine.

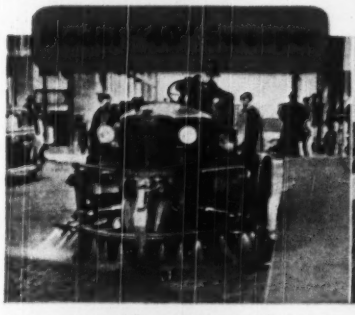


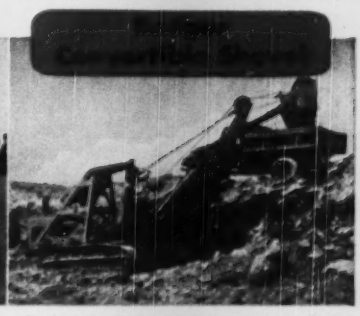




The AUSTIN-WESTERN LINE includes Jaw Crushers and Roll Crushers in a wide range of sizes; plus matching screens, elevators, conveyors and bins. Exclusive features increase output, and reduce maintenance costs.

Skilled engineering characterizes each and every Austin-Western crushing, screening and washing plant, which is tailor-made for a particular production problem. We would welcome the opportunity to discuss yours.





Fast, maneuverable and economical. Dirt is thrown directly into the 2-yard hopper. Right-hand or left-hand gutter broom, or both.

3-WHEELED ROLLERS with hydraulic scarifiers. TANDEM ROLLERS of the variable weight type. All with gas or diesel engines.

The ¾-swing Badger wastes no power swinging extra weight; makes more swings per hour; can work in closer quarters.

Advanced engineering and honest construction characterizes each Austin-Western product. Your nearby A-W distributor will gladly recommend the one best suited to your needs.

AUSTIN-WESTERN COMPANY, AURORA, ILLINOIS, U. S. A.

BUILDERS OF ROAD MACHINERY

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SINCE 1859

Foundation Contract Let for Mississippi Control Project

WORK HAS STARTED on construction of the Morganza Floodway Control Structure, a major project in the lower Mississippi River flood control system, following recent award of a $2,395,570 bid for construction of the pile foundation to the Raymond Concrete Pile Co., of New York. Located 42 miles northwest of Baton Rouge, the control structure will be capable of diverting 600,000 cfs of water from the Mississippi into the floodway through 125 gated bays. The gated portion of the structure will be 4,200 ft long, and each bay will be about 31 ft wide. Tracks of the Texas & Pacific Railway branch line and Louisiana Highway 30 will be located on top of the structure.

Construction of the project, which is scheduled to be ready for operation by January 1, 1953, is under the New Orleans District of the Corps of Engineers. Plans for the structure were made in the Vicksburg office of the Corps.

Chicago Engineers Receive Oklahoma Turnpike Award

A CONTRACT FOR design and supervision of the construction of the $31,000,000 Oklahoma Turnpike connecting Tulsa and Oklahoma City has been awarded to De Leuw, Cather & Co., of Chicago. To expedite work on the 88-mile project, the Chicago firm will establish field offices in Stroud, Sapulpa, and Oklahoma City.

Fulbright Opportunities for Study Abroad Noted

OPPORTUNITIES FOR MORE than 1,000 Americans to undertake graduate study, teaching, or research abroad during the 1951–1952 academic year are announced by the Department of State. Established by the Fulbright Act, which authorizes use of foreign currencies and credits acquired through the sale of surplus property abroad for exchange of students with other nations, the program will permit a similar number of foreign students to come to the United States. Grants to Americans usually include transportation, tuition or stipend, living allowance, and a small sum for necessary books and equipment. Grants to foreign nationals provide for round-trip transportation only, and expenses in the United States must be met from other sources.

Students wishing to do graduate study abroad should apply to the Institute of International Education, 2 West 45th Street, New York 19, N.Y., before October 31. For teaching in national secondary schools abroad (closing date October 15) apply to the Office of Education, Federal Security Agency, Washington 25, D.C., and for teaching in American secondary schools abroad (closing date October 15) apply to the American Schools Service, American Council on Education, 744 Jackson Place, N.W., Washington, D.C.

Large Indian Dam Studied in Colorado A & M College Laboratory

MODEL STUDIES OF Bhakra Dam in India, recently completed at Colorado A & M College, led to recommendations for changes in the design of the dam and appurtenant structures, which will result in improved operation and cost savings in the final structure that will far outweigh the cost of the model studies. One of three Indian dams, for which the college staff has just completed hydraulic model tests, Bhakra Dam will be built on the Sutlej River, a tributary of the Indus, by the State of East Punjab. All three projects are being designed by the International Engineering Co., of San Francisco and Denver, which contracted for the model studies.

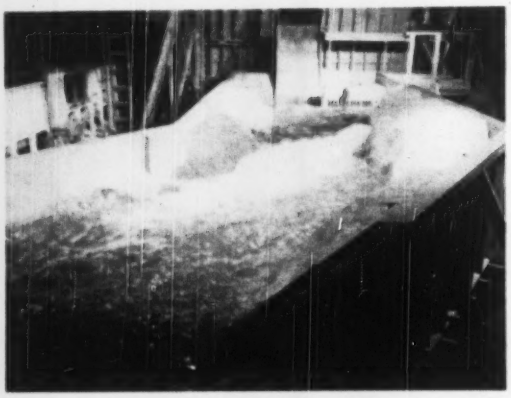
With a maximum height of 693 ft and a central overfall spillway of 560 ft, Bhakra Dam will be the second highest dam, with the highest overfall spillway, in the world. It will be of concrete with a straight gravity section, located in a rather narrow canyon. In addition to the overfall spillway, which will be controlled by two 110-ft drum gates, there will be a 50-ft-dia tunnel spillway in the left abutment, controlled by two 50-ft radial gates on an ogee weir at the left end of the dam proper. There will also be three levels of river outlets, with eight conduits in each, emerging on the spillway face. Combined spillway capacity will amount to 452,000 cfs.

The principal design features that required hydraulic checking were the river scour and stilling basin performance under a variety of operating conditions; tunnel spillway operation; entrance conditions to the tunnel spillway; and operation of the overfall spillway combined with river outlets. A complete model on a 1 to 80 scale and a tunnel spillway model on a 1 to 60 scale were built. The complete model is about 9 ft high, and the full reservoir and downstream river section have a total laboratory length of 55 ft. A flow of nearly 8.0 cfs was required to simulate the maximum prototype flow of 452,000 cfs. Both qualitative and quantitative results were observed in each model.

The 50-ft tunnel spillway presented unusually interesting problems in design. As a result of the tests, the initial design of the entrance and transition section was altered in order to eliminate highly undesirable clogging and spilling over the tunnel portal. To avoid the possibility of cavitation and plugging, with their destructive flow conditions, the tunnel model was made of transparent plastic for qualitative study. Piezometers were installed throughout the transparent transition and tunnel to check quantitatively against the danger of cavitation and pitting. Other studies involved evaluation of entrainment of air on the under side of the nappe coming over the crest of the tunnel spillway to reduce the cavitation tendency, and investigation of the scour in the river bed immediately downstream from the dam.

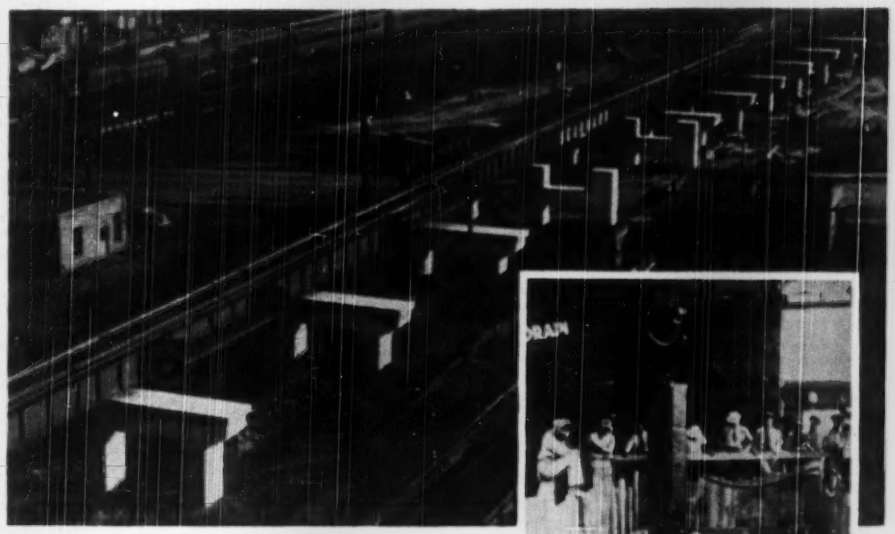
M. R. Chopra, superintending engineer, Irrigation Branch, Public Works Department, East Punjab, India, was liaison officer for his government in Denver during the design. Bruce M. Johnson, M. ASCE, chief designing engineer in the Denver office of the International Engineering Co., was in direct charge of the designs. John L. Savage, Hon. M. ASCE, formerly chief designing engineer for the U.S. Bureau of Reclamation, acted as consultant for the East Punjab Department of Public Works.

The work at the Colorado A & M College Laboratory was under the direct technical supervision of M. L. Albertson, Jun. M. ASCE, as associate professor of fluid mechanics and director of the laboratory. Dr. Albertson supplied the material for this release. Contract work in the laboratory is handled through the Experiment Station, of which Dean T. H. Evans, M. ASCE, is chairman of the Engineering Division, and D. F. Peterson, M. ASCE, is chief of the Civil Engineering Section. Most of the work at the laboratory was done by graduate students. A. J. Peterka, Assoc. M. ASCE, of the Bureau of Reclamation staff, was a consultant on the design and testing of the models.



BHAKRA DAM MODEL, built on 1 to 80 scale, shows high overfall spillway and power house, which will have four turbines and average discharge capacity of 12,500 cfs. Complete model is about 9 ft high.

HOW EXTENDIBLE **MONOTUBE PILES** LICKED LOW HEADROOM



. . . and saved a railroad real money!

TO increase rail capacity into Richmond, Virginia, the Seaboard Airline Railway Company found it necessary to redesign and install 59 piers large enough for double duty. Removing large portions of the old structure and re-routing traffic would have involved tremendous cost and delay. This was avoided by the use of Monotube Steel Piles. Readily extendible, the Monotubes were driven in 10-foot sections—driven *easily* in the many locations allowing only 20 feet of headroom.

Moreover, because Monotubes are light in weight, and easily driven to required bearing values, there was no need for heavy equipment! A light crane with standard equipment was able to work, with a flat boom, in and around the many obstacles . . . quickly, easily, saving still *more* time and expense. Thus 800 Monotubes averaging 20 feet in extended length were driven in only 50 days.

Low headroom is just one of many problems solved by tapered, fluted Monotubes. These modern cast-in-place piles, cold-rolled for high strength, offer exceptional stability and structural values. They come in lengths, gauges, tapers and sizes for varying soil conditions. Jobs started with Monotubes can be *finished* with Monotubes.

But get *all* the facts. Find out how Monotubes can help insure sound construction at minimum cost *whatever* your pile requirements may be. Write to The Union Metal Manufacturing Company, Canton 5, Ohio.

UNION METAL

Monotube Foundation Piles

NEW IN Education

GRADUATE COURSES IN geodetic engineering are being offered by the civil engineering department of the University of Illinois. The first will deal with the principles and practice of precise triangulation, traverse, and levels. The second will comprise a study of the astronomic determination of latitude, longitude, and azimuth; systems of plane coordinates; map projections, and electronic and special control surveys. Address inquiries to Prof. Milton O. Schmidt, Department of Civil Engineering, University of Illinois, Urbana, Ill.

MASSACHUSETTS INSTITUTE OF Technology is scheduling its 12th annual Fall Conference on City and Regional Planning. The Conference, which will consist of morning and afternoon seminar sessions from September 5-15, will be open to qualified professionals and others interested in the technical aspects of planning. Applications should be forwarded to Prof. Frederick J. Adams, Massachusetts Institute of Technology, Room 7-333, Cambridge 39, Mass.

YALE UNIVERSITY, IN cooperation with the Conservation Foundation, is establishing the country's first graduate program of research and construction in conservation of natural resources. Courses will begin in September 1950 under leadership of Prof. Paul B. Sears, now at Oberlin College, who will have the newly created rank of professor of conservation. The prospectus will include courses in plant and animal ecology, geology of soils, oceanography, bio-geochemistry, forestry, and microbiology, with considerable field work in the Connecticut River Valley.

THE UNIVERSITY OF Minnesota Institute of Technology centennial celebration, October 5-7, will be highlighted by the dedication of three new engineering buildings on the campus. Tours will be conducted to various facilities of the Institute, including the St. Anthony Falls Hydraulic Laboratory and the Rosemount Research Center. At the opening-day convocation and alumni dinner, President J. L. Morrill will present outstanding achievement medals to alumni. The North Midwest Section of the American Society for Engineering Education will hold its annual dinner October 6 and a business luncheon meeting on October 7 as features of the program.

CONSERVATION WAS THE theme of a recent meeting of the Ohio Academy of Science, which was held at Capital University in celebration of its centennial and the completion of its new science building. Dr. Paul B. Sears, of Oberlin College, stressed the need for research in formulating effective conservation measures. A new law and setup for administration was outlined by A. W. Marion, director of Ohio State's Department of Natural Resources. John H. Melvin, state geologist, discussed the work of the new department's divisions, and the cooperation received from the Ohio State University Engineering Experiment Station and Research Foundation on studies of properties and uses of materials. Ohio's inventory of water supplies was reviewed by Ralph J. Beruhagen, geologist of the Division of Water.

A NEW CURRICULUM for combined liberal arts-engineering education is announced by six Middle Western colleges—Coe College, DePauw University, Marietta College, Oberlin College, Ohio Wesleyan University, and Case Institute of Technology. The plan, designated the "Binary Curriculum," involves three years of study at one of the liberal arts colleges and two years and a summer of work at Case. Upon completion of the graduation requirements of each institution, the student will receive the bachelor of arts degree from the liberal arts college, at which he has taken his first three years of work, and the bachelor of science degree in a specialized engineering field from Case. The program is described by college officials as a synthesis of two educational experiences, which "should prepare the graduate for more effective participation in our present industrial life."

THE ARMOUR RESEARCH Foundation of the Illinois Institute of Technology has been selected as the technical research center for initial phases of the $1,250,000 research program of the Structural Clay Products Research Foundation. The program will be devoted primarily to end-use research in brick, tile and other structural clay products, with lower in-the-wall masonry costs the main objective. Studies will be made of the effect of unit size, weight, assembly techniques, and other factors to determine combinations that will allow walls to be built most economically.

THE GRADUATE DIVISION of the New York University College of Engineering will offer a new course in "Special Problems in Sanitary and Public Health Engineering" when the academic year begins in September, according to Dean Thorndike Saville. The course, which will be given by Associate Professor William T. Ingram, Assoc. M. ASCE, will cover field investigations, report preparation and oral discussion of housing-sanitation appraisal, community-sanitation planning, public-health engineering administration, water-works and sewage-works operation, industrial sanitation and hygiene, refuse disposal, and insect vector control.

FLUORIDATION WAS THE subject attracting the most attention during a recent three-day session of the North Carolina Water Works Operators School, which was held at the University of North Carolina under the auspices of the Institute of Government and the Department of Sanitary Engineering with sponsorship by the North Carolina Water Works Operators Association. Dr. A. P. Black, of the University of Florida, and Dr. Harry A. Faber, of the Chlorine Institute, acted as visiting lecturers. Charlotte was cited as the only city in the state to practice fluoridation of the public water supply. Total attendance was 77.

Thomas Ellis Brown (M. '24) former manager of the Nassau County (New York) Bridge Authority, died in New York Hospital on June 24, at the age of 60. He graduated from Columbia University in 1912, and after a tour of duty during World War I became associated with the American Bridge Co. For some time he worked with the late Thomas Ellis Brown and the late Dr. J. A. L. Waddell on the design of movable bridges. In 1939 Mr. Brown became chief engineer in charge of the Atlantic Beach Bridge and subsequently assumed his post with the Bridge Authority.

John Bell Cabell (Jun. M. '40) civil engineer with J. E. Sirrine Co., of Greenville, S.C., was killed accidentally in a fall at White Water Falls, S.C., on May 27. He was 34. An honor graduate of Virginia Military Institute, Mr. Cabell received his master's degree on a fellowship at California Institute of Technology, where he later served as an instructor. He had been on active duty with the Corps of Engineers.

Wallace DeRemer Christie (Assoc. M. '45) for a number of years bridge engineer with the Department of Public Works, Tacoma, Wash., died there on June 9, after an illness of several months. He was 56, and a graduate of the University of Michigan. While connected with Weyerhauser Timber Co., Mr. Christie designed automatic wood-working machinery. He also served as design engineer in the Washington State Highway Department at Olympia.

Edward Power Conway (Aff. '29) president, Phoenix-Tempe Stone Co., general contractors of Phoenix, Ariz., died there on June 6, at the age of 69. Mr. Conway had directed many sewer and water developments and paving projects in Southern California and the Southwest. During World War I he served as a member of the AEF general staff in charge of the road department, with the rank of lieutenant colonel. He was a graduate of the University of Wisconsin College of Engineering.

Charles Ivan Day (Assoc. M. '16) president, W. & L. E. Gurley, precision-instrument manufacturing concern of Troy, N.Y., died there on June 22, after a long illness. His age was 68. A 1904 engineering graduate of the University of Maine, he received his master's degree from Cornell the following year. Mr. Day was chief engineer for the Florida East Coast Hotel Co. and vice-president and manager of the Southern Utilities Corp. Since 1919 he had been associated with Gurley, where he served successively as general manager, president, and director.

A. Clinton Decker (M. '25) former sanitary engineer of the Tennessee Coal & Iron

(Continued on page 74)

Are your sludge disposal requirements...

Incineration

Drying for fertilizer

Drying or incineration

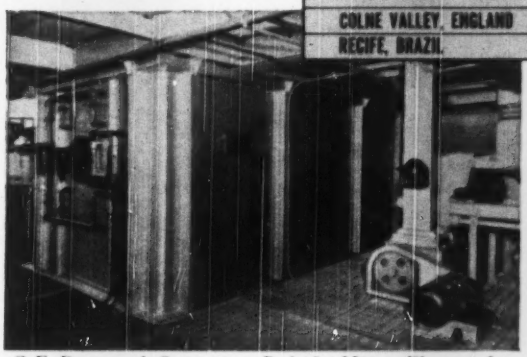
High temperature deodorization

?

THE C-E RAYMOND SYSTEM is the *only* proven method of sewage sludge disposal that can meet any combination of these requirements. It is flexible and efficient... provides for maximum utilization of waste heat.

The table (right) illustrates the adaptability of the C-E Raymond System to the specific requirements of any community.

CITY	INCINERATION	DRYING	DRYING OR INCINERATION	HIGH-TEMPERATURE DEODORIZING
CHICAGO, ILLINOIS				
CALUMET			✓	✓
SOUTHWEST			✓	✓
WEST SOUTHWEST			✓	✓
BUFFALO, NEW YORK	✓			✓
TENAFLY, NEW JERSEY		✓		✓
SPRINGFIELD, MASS.			✓	
NEENAH-MENASHA, WIS.	✓			✓
WATERVLIET, NEW YORK	✓			✓
CUYAHOGA FALLS, OHIO	✓			
DULUTH, MINNESOTA			✓	✓
MANITOWOC, WISCONSIN		✓		
SAN DIEGO, CALIFORNIA		✓		✓
STAMFORD, CONNECTICUT			✓	✓
SHEBOYGAN, WISCONSIN		✓		✓
BATTLE CREEK, MICHIGAN		✓		
SAN DIEGO, CALIF. EXTEN.		✓		✓
HOUSTON, TEXAS		✓		
LOS ANGELES, CALIFORNIA			✓	✓
FOND DU LAC, WISCONSIN		✓		✓
SAN FRANCISCO, CALIF.		✓		✓
BALTIMORE, MARYLAND		✓		
WATERBURY, CONNECTICUT			✓	✓
COLNE VALLEY, ENGLAND			✓	✓
RECIFE, BRAZIL		✓		



C-E Raymond System at Duluth, Minn. Photo taken from operating floor showing part of furnace.

All inquiries on the C-E Raymond System should be directed to the nearest office of The Dorr Company, world sales representatives in the Sanitary Engineering Field.

In sewage treatment...there's a Dorr Unit for practically every step in every flowsheet.

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Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

DORR

RESEARCH ENGINEERING EQUIPMENT

(*Continued from page 72*)

Railroad Co., Birmingham, Ala., died suddenly May 22, at the age of 63. Mr. Decker worked on many sanitary engineering projects, including the design and construction of Chickasaw, Ala., water and sewerage works. He had also been a member of the Engineering Commission for Industrial Water Supply for the City of Birmingham. He was a Cornell University graduate, class of 1909.

Lawrence Rasmus Hjorth (M. '31) consulting civil and structural engineer and partner in the firm of Edwards & Hjorth, of New York City, died at Calais, Me., on July 9, at the age of 62. After service with the AEF during World War I, Mr. Hjorth joined the staff of H. G. Balcolm & Associates, becoming a partner in the organization in 1933. Some time later he was made a member in the concern of Edwards & Hjorth, where he worked on such structural designing projects as the Esso Building and the UN Secretariat Building. He was a graduate of the University of Washington.

William Jethro Howland (M. '20) county superintendent of highways of Delaware County (New York), died at Melrose, Mass., on July 8, at the age of 65. Mr. Howland had been associated with many railroads, directing location surveys and construction. As a member of the Quartermaster Corps' Construction Division during the first World War, he was in charge of construction of Camp Furlong, Columbus, N. Mex., and others.

Kirby V. Jones (M. '31) died in Charlotte, N.C., on April 6, at the age of 60. Prior to the past five years, Mr. Jones was on the AEC plants at Oak Ridge and Hanford Works and resident engineer on the construction of Buggs Island Dam. Earlier he had been with the Miami Conservancy District at Dayton and Englewood dams; on hydro power projects at Waterloo and Utica, N.Y.; Martin and Jordan dams in Alabama; and Carpenter Dam in Arkansas. He was also assistant to the chief engineer for the first contractors on Grand Coulee Dam, and had engaged on water power installation for the Firestone Plantations in Liberia, Africa. In World War I he was with the 90th Division on the St. Mihiel and Argonne offensives.

Kirby V. Jones

Narasimha Krishna Murthy (Assoc. M. '48) assistant executive engineer, Military Engineer Services, of Bangalore, India, died May 6, at the age of 32. He received his master's degree in sanitary engineering from the Harvard University School of Engineering and a diploma in sanitary engineering from the U.S. Public Health Service. Mr. Murthy had instructed in sanitary engineering at the School of Military Engineering.

Sterry Jencks Mahaffey (Assoc. M. '41) engineer-director of the Virginia Road Builders' Association for the past four years, died suddenly in Baltimore, Md., on July 1. He was 46. He received his training at Pennsylvania State College and the University of Richmond, joining the Virginia Department of Highways in 1926 as a bridge inspector and serving later as resident engineer of several municipalities. About ten years ago Mr. Mahaffey was named manager of Henrico County. At the time of his death he was serving the Society as president of the Virginia Section.

John Moore Picton (M. '44) chief planning engineer for the City Plan Commission, of Kansas City, Mo., died in Washington, D.C., on May 19. He was 47. Since 1943, Mr. Picton had been supervising and directing the preparation of a master plan for progressive development in Kansas City and vicinity. Earlier he had been assistant engineer with the Hamilton County (Ohio) Regional Planning Commission, developing a master plan for the City of Cincinnati and its environs. During the recent war he was with the National Housing Agency and the National Resources Planning Board.

William Babcock Poland (M. '03) physicist, Naval Research Laboratory, Anacostia, Md., died in Washington, D.C., on June 27, at the age of 82. He graduated from Massachusetts Institute of Technology, and at one time had a consulting practice in New York. He was responsible for numerous river and harbor improvements in the New England coastal area, and for the railway system in Persia, where he laid out the railway line from the Caspian Sea to the Persian Gulf. During World War II Mr. Poland was chief economic consultant to the Board of Economic Warfare.

deWitt Rapalje (Assoc. M. '10) retired civil engineer and specialist in fire prevention and safety engineering, of Plainfield, N.J., died in Maplewood, on June 23, at the age of 69. A graduate of Rutgers University in 1900, he was alumni secretary of his class. Several years ago he served as a member of the committee that revised Plainfield's zoning code and acted as supervising engineer for the city during the erection of emergency housing projects for veterans. During World War I and II he was a civilian employee of the government working on fire prevention.

John M. Rice (M. '17) Pittsburgh, Pa., consultant, died there on June 24, at the age of 65. Founding his consulting firm in 1921, Mr. Rice was active in many of the public improvements in and near Pittsburgh. He was chief engineer of the Allegheny County Authority during the time the Homestead High Level project was constructed over the Monongahela River. For several years he taught special classes at the University of Pittsburgh and Carnegie Institute of Technology.

John M. Rice

Samuel Howard Rippey (M. '08) retired consulting engineer, of Philadelphia, Pa., died there on May 18. He was 74. Upon his graduation from Drexel Institute of Technology, Mr. Rippey entered the employ of Coleman Sellers, president and chief engineer of the Niagara Falls Power Co., working on hydroelectric power development. In 1906 he became a partner in the concern of Sellers & Rippey.

Leon Monroe Schoonmaker (M. '30) consulting engineer, of Forest Hills, N.Y., died on May 30, at the age of 68. He was a graduate of Princeton University in 1904. For many years Mr. Schoonmaker acted as consultant to the Long Island highway system, the Queens Planning Commission, and the Queens Advisory Planning Board. During World War I he served with the AEF in France.

Edward Gwyn Sheibley (M. '20) Fresno, Calif., consultant, died on April 3. He was 71. Mr. Sheibley received engineering degrees from Stanford and Harvard universities. Prior to engaging in private practice he was sanitary engineer and chief of the Bureau of Housing and Sanitation for the City of Los Angeles, and chief engineer and superintendent of safety of the Industrial Accident Commission for the state of California.

Robert Kingsley Tomlin (M. '43) of Forest Hills, N.Y., former editor of *Construction Methods and Equipment*, a McGraw-Hill publication, died on July 4 in a New York hospital, at the age of 64. He was a graduate of Harvard University, class of 1907. Before joining McGraw-Hill in 1909, Mr. Tomlin served on the construction of the Pennsylvania Railroad tunnels into New York and of the Catskill Aqueduct. During the first World War he acted as war correspondent for *Engineering News-Record*, covering work of the Army Corps of Engineers. He was cited by General Pershing for his service as officer-in-charge of the technical information section in Tours, France.

Robert Garnett Waggener (M. '27) retired consulting engineer of Fort Worth, Tex., died there on June 26. He was 65. During his career Mr. Waggener supervised and aided in construction of Texas railroads and railroad yards in Fort Worth, Dallas, Marshall, and other cities.

Harald Malcolm Westergaard (M. '27) former Gordon McKay professor of civil engineering at Harvard University since 1936 and dean of the graduate school of engineering from 1937–1946, died in Cambridge, Mass., on June 22, at the age of 62. Following his graduation from the Royal Scientific College in Copenhagen, Denmark, in 1911 and three years of engineering practice, he went to the University of Illinois on a fellowship from the American Scandinavian Foundation. In 1916 he received his Ph.D. and was appointed to the University of Illinois faculty, rising through the various academic ranks. An authority on elasticity, Professor Westergaard had served in engineering capacities with the Bureau of Public Roads, the Bureau of Reclamation, and the U.S. Navy. His analysis of highway slabs is still used in the design of concrete pavements. Honors recently awarded him include the 1949 Thomas Fitch Rowland Prize.

NEWS OF Engineers

Michel A. Saad, assistant professor of civil engineering at Johns Hopkins University, has been named by the State Department visiting professor to the college of engineering of the National University of Syria for the year 1950–1951. In addition to his teaching duties Professor Saad will advise on the expansion of the civil engineering department there. He has been on the faculties of the University of Texas, Cornell University, and North Dakota A & M College. He seryed as Faculty Adviser of the ASCE Student Chapter at Johns Hopkins.

Michel A. Saad

Gen. Lucius D. Clay, ASCE Honorary Member, was recently appointed chairman of the newly organized New York State Civil Defense Commission, with headquarters in New York City. About a year ago General Clay returned from overseas, where he had been military governor of Germany.

Thomas E. Huffman, since 1945 engineer-manager of the Dallas Urban Expressways of the Texas Highway Department, has been named highway manager of the Dallas Chamber of Commerce. **R. E. Killmer** succeeds him on the expressways project.

Carl J. Bernhardt, for the past 12 years district sanitary engineer of the New York State Health Department in Jamestown, has become regional sanitary engineer in the Buffalo area.

William Whipple, Jr., colonel, Corps of Engineers, serving as Walla Walla, Wash., district engineer, has been transferred to the Armed Forces Industrial College in Washington, D.C., for a course in industrial mobilization. Construction of McNary Dam on the Columbia River is being directed from the Walla Walla District office.

Gail A. Hathaway attended the Fourth World Power Conference held in London, July 10–15, as member of the United States delegation. As chairman of the United States committee, he also attended a meeting of the International Commission on Large Dams. Mr. Hathaway is special assistant to the Chief of Engineers, Washington, D.C.

Charles W. Bryan, Jr., has been elected president of the Pullman-Standard Car Manufacturing Co., railway car building subsidiary of Pullman, Inc., with headquarters in New York City. Mr. Bryan was associated with the Federal Shipbuilding and Dry Dock Co., of which he was vice-president and general manager in 1948 when

(*Continued on page 76*)

(*Continued from page 75*)

its Kearny shipyard was sold to the U.S. Navy. As consultant to the Economic Cooperation Administration, he worked on shipbuilding and shipping matters in Italy.

Clark M. Kee, consulting engineer of Cambridge, Mass., announces that his contract with the Hawaiian Aeronautics Commission covering the design of a master plan for the Honolulu Airport and an administration building, has been extended for a six-month period. The scope of the work has also been increased to include a master plan design and administration building for Hilo, Hawaii and Kahului, Maui.

Former President **Herbert Hoover,** ASCE Honorary Member, was honored recently by the American Alumni Council as the "American alumnus of the year." Mr. Hoover is a Stanford University graduate, class of 1895. The award, consisting of a decorated volume, was made in absentia at a dinner that closed the annual conference at Harvard University Graduate School of Business Administration.

Walter E. Riley and **Frank J. Foltz** have established a consulting office for the practice of civil engineering in Phoenix, Ariz.

Jerome H. Fertig, who has been on the Bureau of Reclamation staff for 29 years, was recently awarded an Interior Department citation for meritorious service on the investigation and planning of the $30,000,000 Cachuma project in California.

William S. Hanley has retired as chief engineer of the St. Louis, Southwestern Railway Lines, with headquarters at Tyler, Tex.

Foster B. Crocker, who has served 45 years in the New York State Department of Public Works, recently as associate engineer in the Syracuse district engineer's office, will retire on September 1. Mr. Crocker directed construction work on the Barge Canal.

Gilmore D. Clark, after 12 years as dean of the Cornell University College of Architecture, has retired. He will be retained on the faculty as professor of landscape architecture.

William E. Dobbins has been appointed associate professor of sanitary engineering in the New York University College of Engineering, effective September 1. Previously, Mr. Dobbins was associated with Fay, Spofford & Thorndike, consulting engineers of Boston, Mass.

Theodore K. Rothermund has joined the Newark, N.J., industrial engineering concern of W. W. Slocum & Co., as chief engineer. As head of the engineering division, he will have charge of engineering design and supervision of construction of the organization's industrial projects. Previously, Mr. Rothermund was manager for the H. K. Ferguson Co., in South America.

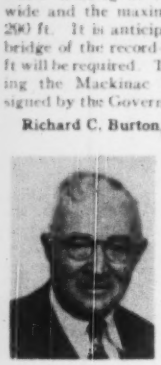
Affiliated Photo Service

T. K. Rothermund

J. P. Mills, Jr., of the Virginia State Highway Department, Richmond, Va., has been appointed to the position of assistant traffic and planning engineer. In this capacity he will coordinate the work of traffic and planning divisions, including parking surveys, traffic studies preparatory to highway construction, urban traffic studies, and the preparation of Virginia's official highway map.

D. B. Steinman and **O. H. Ammann,** of New York, and **G. B. Woodruff,** of San Francisco, have been selected by the Mackinac Bridge Authority as a Board of Engineers to make a study and report covering the physical and economic feasibility, location, general design, and estimate of cost of a bridge to be constructed across the Straits of Mackinac, to connect the upper and lower peninsulas of Michigan. The water crossing at the strait is four miles wide and the maximum depth of water is 200 ft. It is anticipated that a suspension bridge of the record-breaking span of 4,600 ft will be required. The legislation establishing the Mackinac Bridge Authority was signed by the Governor of Michigan in June.

Richard C. Burton, who recently returned from Venezuela, where he was employed by the Frederick Snare Corp., as chief engineer and assistant general superintendent on construction of an ore transfer station for the Bethlehem Steel Co., has rejoined the United Fruit Co. He will represent the organization on the Weehawken, N.J., terminal project.



Richard C. Burton

Frederick H. Zurmuhlen, New York City commissioner of public works, recently received the 1950 Annual Award of the New York Association of Consulting Engineers in recognition of his contributions during the past year in furthering the aims of the association—an organization of 40 consulting engineering firms in New York City.

W. L. Shannon, formerly with the Corps of Engineers at Portland, Ore., has become a member of the firm of William D. Shannon & Associates, Seattle, Wash.

William A. Hardenbergh has been appointed consulting engineer for the New York City Department of Health to coordinate and direct rat extermination projects of all city departments and agencies. During the war Colonel Hardenbergh served as chief sanitary engineer of the Army, with headquarters at Washington, D.C.

William S. Housel has been elevated to the rank of professor of civil engineering at the University of Michigan.

Ernest Hillman, of the Los Angeles structural engineering firm of Hillman & Nowell, is president of the Structural Engineers Association of Southern California.

Max L. Mitchell, of Clinton, Ind., has been appointed engineer in charge of a program to evaluate the water resources of the state.

John S. McNown has been awarded a Fulbright research scholarship to the University of Grenoble in France for the 1950–1951 academic year. He will be on leave from the State University of Iowa, where he is an associate professor of mechanics and hydraulics and a research engineer in the Institute of Hydraulic Research. The award, which is sponsored by the State Department, will make it possible for Professor McNown to conduct research at the internationally known Neyrpic laboratories during the spring of 1951 as an exchange professor. He will sail from New York in October.

John S. McNown

Capt. E. B. Keating, CEC, USN, was honored at recent Navy ceremonies on his retirement from the public works office of the Potomac River Naval Command, in Washington, D.C. Captain Keating was cited for his "substantial contribution to the discharge of our mission in the defense of our country during the first and second World Wars."

Robert F. Coleman, Jr., since 1947 assistant city engineer at Wilmington, N.C., has been appointed acting city engineer, succeeding **Henry M. von Oesen,** who resigned recently to enter private practice.

John W. Odell, formerly in the Ithaca, N.Y., office of the U.S. Geological Survey, has been transferred to Salt Lake City, Utah.

Brendan P. O'Hara has been named sales engineer of the Universal Concrete Pipe Co., with headquarters in New York City. Previously, Mr. O'Hara was associated with the Universal-Atlas Cement Corp. in Philadelphia, Pa.

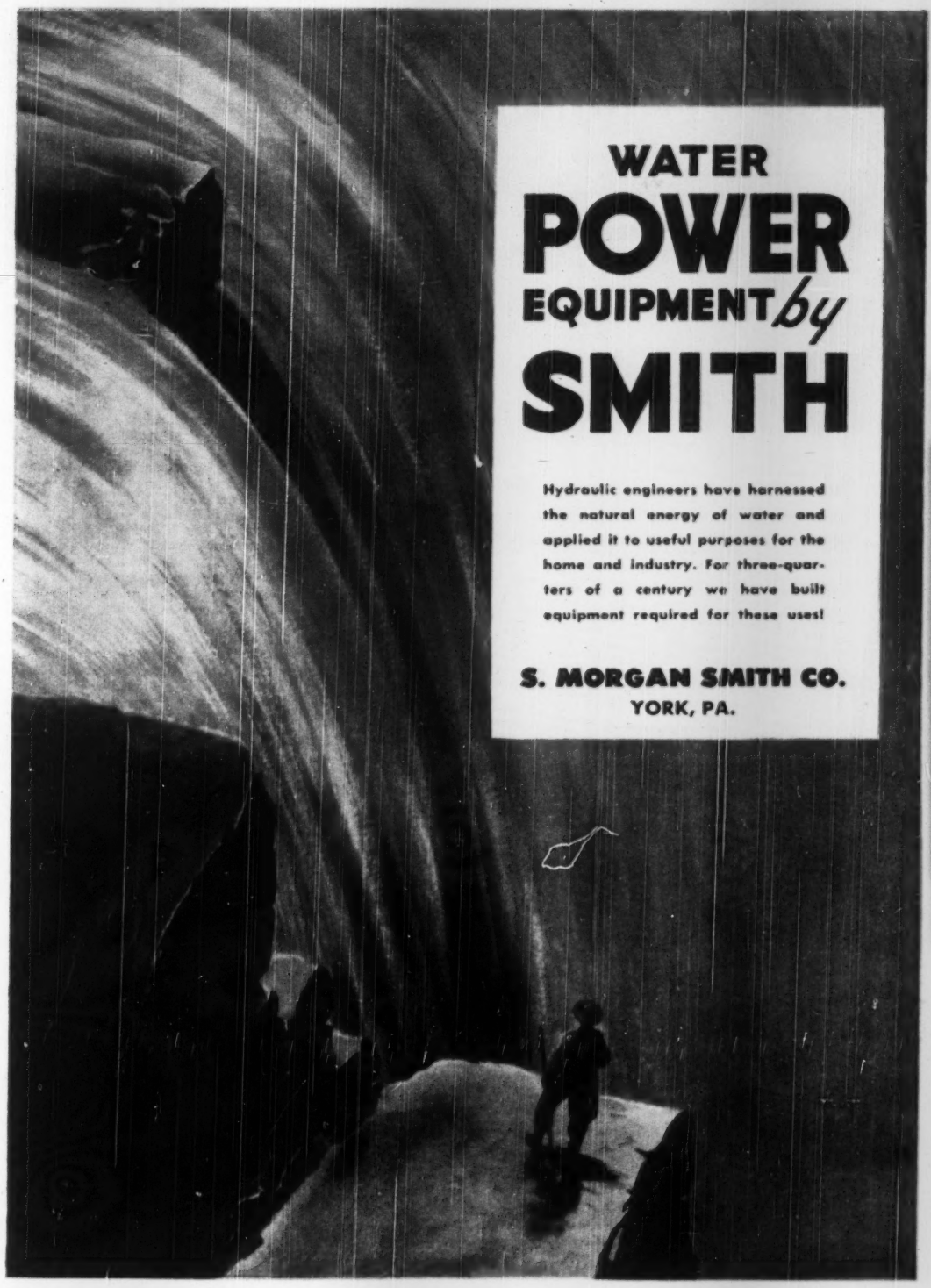
J. N. Finlayson has retired as dean of applied science at the University of British Columbia, Vancouver, after 14 years of service. Previously, Dean Finlayson was on the University of Manitoba faculty, and he has also engaged in private consulting practice.

Roger D. Ley, for the past four years assistant hydraulic engineer of the Western Massachusetts Electric Co., at Turner Falls, Mass., has been promoted to the position of hydraulic engineer.

E. A. Wood has been made head of the newly created zoning enforcement department in Dallas, Tex.

Edmund A. Prentis, partner in the firm of Spencer, White & Prentis, Inc., of New York City, was awarded a certificate for his outstanding service in standardization at the president's annual luncheon of the American Standards Association.

A. N. Murray, former regional water rights engineer of the U.S. Bureau of Reclamation, at Sacramento, Calif., has been named regional planning engineer of that city. **L. K. Hill,** who has been chief of the Allocation and Economics Division, will succeed Mr. Murray.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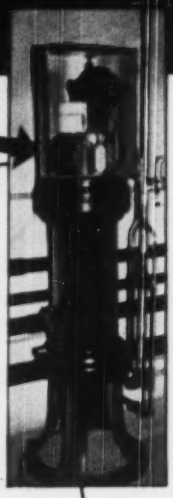


City of Fargo
WATER WORKS DEPARTMENT

September 14, 1949

Simplex Valve & Meter Company
6th & Upland Streets
Philadelphia 42, Pennsylvania

Attention: Mr. R. A. McQuade

Gentlemen:

Our oldest Simplex Venturi Meter Serial No. 18-08-266-6D, as near as we can learn, was installed in the pumping plant here at Fargo, North Dakota, in 1913 to measure the flow of water going out to the city. This meter is still in continuous service having been overhauled in about 1929. It still has the original clock drive mechanism which came with it.

We have three other Simplex Meters in use. Serial No. 16-06-016-6K was installed in 1922; Serial No. 18-179-2213-6K was installed in 1929; Serial No. 18-68-4546-6C was installed in 1938. The clock mechanism in these meters has been changed to electric clocks except the oldest one for which a new clock has been ordered.

All of these meters are in continuous operation and require almost no attention whatever except to check accuracy and make slight adjustments once in two years. This work can be done by our own men.

We certainly feel that our past experience with Simplex Meters qualifies us to recommend them to anybody, anywhere.

Very truly yours,

CITY OF FARGO WATER DEPARTMENT
H. H. Behlmer
H. H. Behlmer,
Asst. Supt. Water Department

IT'S SIMPLEX
IT'S ACCURATE

When you purchase Simplex equipment, of whatever type, you will find the same features of ruggedness, long life, low maintenance cost, and accuracy as did the user of the meters at Fargo, North Dakota.

For full information, write to Simplex Valve & Meter Company, Dept. 8, 6724 Upland Street, Philadelphia 42, Pa.

SIMPLEX
VALVE AND METER COMPANY

Meetings and Conferences

American Chemical Society. "A half century of chemical progress" will be the theme of the national chemical exposition, sponsored by the Chicago section of the American Chemical Society, in the Chicago Coliseum, September 5–9.

American Society of Planning Officials. Technical sessions and social events of the national planning conference of the American Society of Planning Officials will take place at the Hotel Biltmore, Los Angeles, Calif., August 13–16.

Conference on Ground Facilities for Air Transportation. A full program is planned for the Conference on Ground Facilities for Air Transportation at Massachusetts Institute of Technology, Cambridge, Mass., September 12–14.

Illuminating Engineering Society. The Illuminating Engineering Society will hold its national technical convention at the Hotel Huntington, Pasadena, Calif., August 21–24. All registrations and reservations are being handled by I.E.S. headquarters at 51 Madison Avenue, New York 10, N.Y.

Instrument Society of America. Sponsored by the Instrument Society of America, the fifth national instrument exhibit will open in the Memorial Auditorium, Buffalo, N.Y., for the week beginning September 18.

National Research Council. The second research correlation conference of the Building Research Advisory Board of the National Research Council is scheduled for the National Academy of Sciences, Washington, D.C., on September 26.

Pennsylvania Water Works Operators' Association. Headquarters for the 23rd annual meeting of the Pennsylvania Water Works Operators' Association will be at State College, Pennsylvania, August 21–23.

Society of Automotive Engineers. Headquarters for the West Coast meeting of the Society of Automotive Engineers will be the Biltmore Hotel, Los Angeles, Calif., August 14–16.

Positions Announced

State Planning Commission, Maryland. Announcement of examinations is being made by the Maryland State Planning Commission for the following positions: Economist ($4,500–$5,625); Research Analyst ($3,600–$4,500); Planning Engineer I ($5,000–$6,250); Planning Engineer II ($3,840–$4,800); and Site Planner ($4,500–$5,625). Applications and more detailed information may be obtained from the State Employment Commissioner, Department of State Employment and Registration, 31 Light Street, Baltimore 2, Md.

Recent BOOKS

ENGINEERING ECONOMIC ANALYSIS. 2 ed. By C. E. Bullinger. McGraw-Hill Book Co., New York, Toronto, London, 1950. 397 pp., diagrs., charts, tables, 9¼×6 in., cloth, $4. The four main divisions of this text deal respectively with the following aspects of an engineering project: The economy analysis, concerned with the problem of yield on the investment; the financial analysis, dealing with the provision of funds; the analysis of intangibles, evaluating the factors in which human judgment is involved; and special methods and applications, as in the consideration of the economic characteristics of power-generating and power-using equipment. Tables and formulas for the necessary calculations are provided in appendixes.

ENGINEERS OF THE SOUTHWEST PACIFIC, 1941-1945. Volume VII, Engineer Supply, by the Office of the Chief Engineer, General Headquarters, Army Forces, Pacific. Reports of Operations, United States Army Forces in the Far East, Southwest Pacific Area, Army Forces, Pacific, 1947. 366 pp., illus., charts, maps, tables, 11¾×9 in., cloth, $5, for sale by Superintendent of Documents, Government Printing Office, Washington 25, D.C. This seventh volume of the series on the "Engineers of the Southwest Pacific, 1941-1945" is a detailed report of supply activities and provides data on the various training, research, development, and supply agencies operating under the Corps of Engineers. All problems of supply are covered from the beginning of the war through the early stages of the occupation of Japan and Korea.

ENGINEERING PRECISION MEASUREMENTS. 2 ed. revised. By A. W. Judge. Chapman & Hall Ltd., London, W.C. 2, 1950. 363 pp., illus., diagrs., charts, tables, 9¾ × 5½ in., cloth, 30s. This book provides a general survey of the more important methods of precision measurements employed in the engineering workshops, and describes in detail some of the more widely used methods from the viewpoint of the user in the gage room, inspection department, toolroom, and machine shop. For some cases, the principles of the methods upon which the instrument is based are given, and typical examples are described. An abridged account of important recent advances in this field is also included.

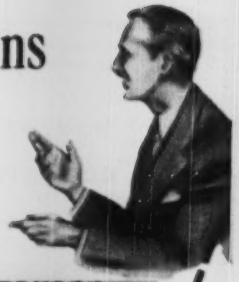
INFLUENCES ON CONCRETE. By A. Kleinlogel, translated from the German (*Einflüsse auf Beton*) by F. S. Morgenroth. Frederick Ungar Publishing Co., New York, 1941. 281 pp., diagrs., charts, tables, 10½ × 6¾ in., cloth, $7.50. An English translation of the 1941 German edition, this volume is an encyclopedia of the chemical, mechanical, and other affects of air, water, acids, bases, oils, steam, earth, vibrations, storage, and the like on cement, mortar, concrete, and reinforced concrete. Measures to decrease and prevent these influences are briefly noted.

KENT'S MECHANICAL ENGINEERS' HANDBOOK (Wiley Engineering Handbook Series.) Vol. I, Design and Production Volume, edited by C. Carmichael. Vol. II, Power Volume, edited by J. K. Salisbury. John Wiley & Sons, New York; Chapman & Hall, London, 12th ed., paged in sections, 1950. Illus., diagrs., charts, tables, 8½ × 5½ in., leather, $8.50 per volume. Volume I, now primarily directed toward the engineers who design and manufacture machinery, appliances, mechanical equipment, and other engineered products, provides a summary of the essentials of the field. Volume II, thoroughly revised and rewritten, covers the entire field of heat-power engineering and transportation as well as the important aspects of fluid flow.

(The) MARKET FOR COLLEGE GRADUATES. By S. E. Harris. Harvard University Press, Cambridge, Mass., 1949. 207 pp., diagrs., charts.

(Continued on page 80)

Your engineering plans are in competent hands



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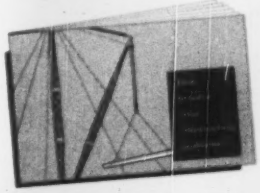

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DEPARTMENT OF THE INTERIOR

BUREAU OF BUILDINGS

SANTURCE, PUERTO RICO

Date July 15, 1950

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Sealed proposals will be received by the Commissioner of the Interior of Puerto Rico at his office, Santurce, Puerto Rico, until 2:00 P.M. on October 20, 1950, and then be publicly opened and read aloud, for furnishing all plant, labor, and materials and performing all work required for THE CONSTRUCTION OF VARIOUS BUILDINGS FOR THE INSULAR PSYCHIATRIC HOSPITAL AT RIO PIEDRAS, PUERTO RICO.

Prospective bidders may submit bids for any one or all or any combination of the following Contract Areas as indicated on the Site Plat:

Contract Area I

1—Building "A"—Administration and Reception Building

Contract Area II

1—Building "B"—Tuberculosis Building

Contract Area III

1—Building "C"—Chronic Disturbed Building—Men
2—Building "D"—Chronic Disturbed Building—Women
3—Building "F"—Industrial Patients Building—Men
4—Building "G"—Industrial Patients Building—Women
5—Building "H"—Industrial Patients Building—Women
6—Building "I"—Inactive Patients Building

Plans, specifications, and all pertinent contract documents may be obtained at:

1—Department of the Interior—Santurce, Puerto Rico
2—Office of Puerto Rico, 1026 17th Street, N.W., Washington 6, D. C.
3—Office of Puerto Rico, 1881 Broadway, New York, N. Y.

upon deposit in cash, money order, or certified check payable to the Commissioner of the Interior of Puerto Rico in the amount or amounts indicated below:

1.	Complete Plans and Specification	$225.00
2.	Architectural Section & Specification	$ 90.00
3.	Structural Section & Specification	$ 55.00
4.	Mechanical Section & Specification	$ 80.00

The full amount of the deposit or deposits will be refunded to the depositor upon return of the above documents in good condition within a period of THIRTY (30) DAYS after the date of the opening of bids.

Each proposal must be accompanied by a provisional bond in cash, bid bond or certified check payable to the Commissioner of the Interior of Puerto Rico for not less than the amounts indicated in the proposal form.

Special attention is called to the bidders that plans, specifications, and contract documents may be obtained only up to Sept. 30, 1950, and that any bid which does not contain the prices written in letters and figures will be rejected.

The Board of Awards reserves the right to reject any or all bids and to waive informalities.

Engineer's Estimate

Contract Area I	$1,050,000.00
Contract Area II	500,000.00
Contract Area III	1,625,000.00

JORGE I. JIMENEZ
Commissioner of the Interior

(Continued from page 79)

tables, 8½ × 5½ in., cloth, $4. Proceeding on the premise that the number of college graduates is steadily outstripping the number of jobs available within the chosen professions, the author presents first a general survey of the problem and then a detailed analysis and documentation. The related aspects of education and income are discussed, and certain solutions are proposed for relieving the general situation and eliminating some of the special difficulties.

PLANT LAYOUT AND MATERIALS HANDLING. By J. M. Apple. Ronald Press Co., New York, 1950. 567 pp., illus., diagrs., charts, maps, tables, 9¼ × 6½ in., cloth, $5. Presented from an engineering standpoint, this book shows how to develop the most efficient layouts of equipment and of operating and service facilities for manufacturing plants, warehouses, and other industrial or business applications. Emphasis is on the major problem of essential coordination between plant layout, materials handling, engineering methods, production planning, and control. A bibliography and many illustrations are included.

PROBLEMES DU PROJET ET DE L'ETABLISSEMENT DE GRANDS SOUTERRAINS ROUTIERS ALPINS. By C. Andreae. Leemann Editeur, Zurich, Switzerland, 1949. 50 pp., illus., diagrs., charts, tables, 8½ × 6 in., paper, 7.90 Sw. Frs. This pamphlet discusses briefly the question of vehicular tunnels through high mountains, with special attention to the problem of ventilation which occupies approximately half of the pamphlet. There is a bibliography.

Books in the Engineering Societies Library may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains research and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

RAPID TRAVERSE TABLES. By L. J. Goldsmith. Wm. C. Brown Co., Dubuque, Iowa, 1950. 540 pp., diagrs., tables, 8½ × 5½ in., stiff paper, $6. The products of the natural sines and cosines of angles multiplied by the numbers from one to nine are tabulated for each minute of angle from 0°01' to 89°59'. The values listed are accurate to five figures following the decimal point. The tables are particularly applicable to problems in which the hypotenuse and an adjacent angle of a right triangle are known, such as are found in trigonometry, applied mechanics, and surveying. A special rapid calculator devised for use with the tables is included.

STRENGTH OF MATERIALS, 5th ed. By J. E. Boyd, revised by S. B. Folk. McGraw-Hill Book Co., New York, Toronto, London, 1950. 417 pp., illus., diagrs., charts, tables, 9¼ × 6½ in., cloth, $4.25. In the new revision of this standard text, a special attempt has been made to emphasize the fundamentals of the theory and to accept the process of analysis in the application of mathematics to strength of materials. The utilization of fundamental ideas, physical constants, and reasonable stresses with a minimum of memory formulas is intended to provide the student with a useful working knowledge of the subject. Revisions have been made with regard to recent developments and present-day interpretation.

SYMPOSIUM ON EFFECTS OF LOW TEMPERATURES ON THE PROPERTIES OF MATERIALS. (Special Technical Publication No. 78.) American Society for Testing Materials, Philadelphia 3, Pa., 1950. 62 pp., illus., diagrs., charts, tables, 9 × 6 in., paper, $1.50. This symposium of four papers and discussions brings together some of the existing knowledge of the low temperature use of plastics, elastomers such as rubber, non-ferrous metals, and metal welds. Suggestions for future work in this field are outlined.

(THE) TRAFFIC DICTIONARY, 4th edition, enlarged and revised. By G. T. Stufflebeam. Simmons-Boardman Publishing Corp., New York, 1950. 292 pp., 6½ × 4½ in., fabrikoid, $3.75. Definitions are given for more than 1,800 everyday traffic terms; 1,200 abbreviations are identified; and the names and reporting code marks are listed for 1,000 North American railroads, private car lines, and steamship lines. The subject matter includes the preparation, recording, and handling of shipments, warehousing, claim procedures, export and import transactions, and rules and regulations. New material has been added in this enlarged edition.

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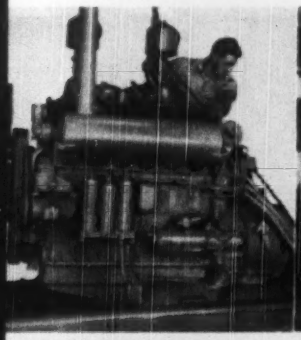
Another Big Reason Why HD-19 Leads in Tractor Output

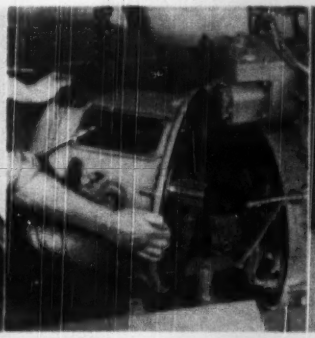
Gears, pinions and bearings by the dozen have been eliminated in the HD-19. This means fewer parts to wear — fewer breakdowns and fewer repair bills.

When maintenance is necessary, each assembly is readily accessible for attention. The HD-19 is designed so that each major unit may be easily removed and repaired or replaced *right on the job* without removing unrelated parts. The time and labor saved means substantial increases in the HD-19's over-all output. Remember, a tractor makes money for an owner only when it's working.

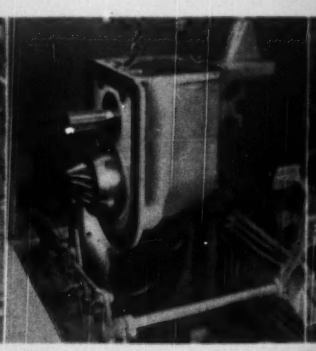
Simple unit assembly is another important reason why the HD-19 is low in total down time required for servicing and maintenance . . . why it is tops in output per day, per month, per season.



Engine can be removed without disassembling clutch.

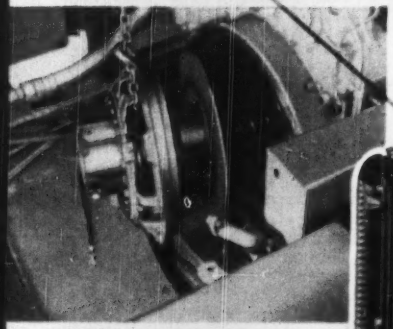


Torque converter can be removed without disturbing engine or transmission.

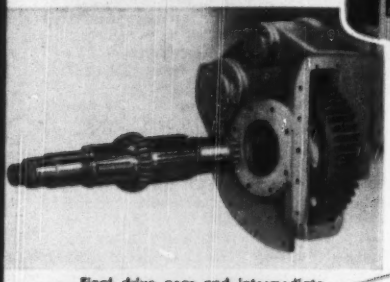


Transmission can be removed as a complete unit without removing clutch, final drive or bevel gear.

Each steering clutch can be removed independently and without disturbing final drive or bevel gear.



Clutch assembly can be removed without disturbing either engine or transmission.



Final drive gear and intermediate gear can be removed without disturbing steering clutch.

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- Torque Converter Drive
- 40,000 lb. of Balanced Weight
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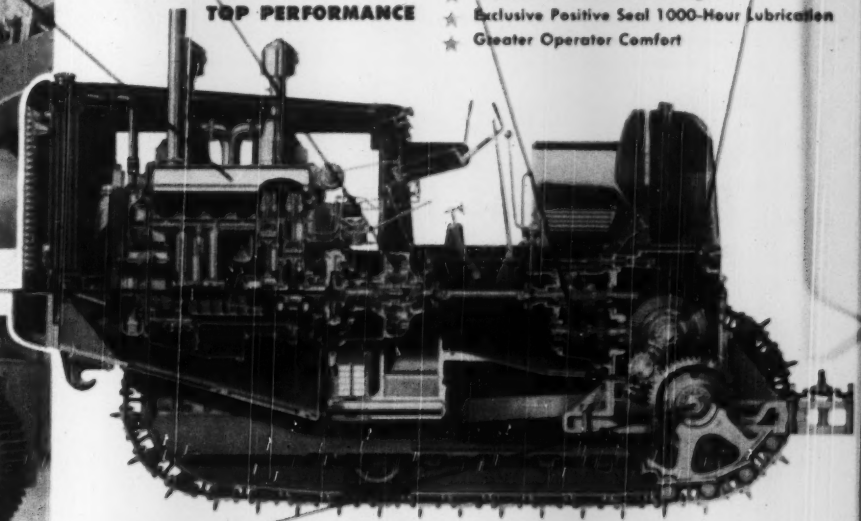

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New Publications

Engineering Specifications. A lecture on writing specifications, recently presented to senior civil engineers at the University of Mississippi by R. A. Harris, chief engineer for the Mississippi State Highway Department and lecturer in construction engineering at the university, has been issued as Bulletin No. 2 by the university. Copies are available on request to the School of Engineering, University of Mississippi, University, Miss.

Industrial Research. A selected and annotated bibliography of books and articles has been issued under the head of *Management of Industrial Research* by Arthur D. Little, Inc., pioneer consulting industrial research and engineering organization. For free copies write Arthur D. Little, Inc., Memorial Drive at Kendall Square, Cambridge 42, Mass.

Mapping. Principal streams of Ohio and their drainage areas are shown on a new map of the state issued by the Division of Water of the Ohio Department of Natural Resources. Copies may be obtained from the Department, Administration Building, Ohio State Fairgrounds, Columbus, Ohio.

Machinery Foundations. Issuance of a list of 120 annotated references to selected books and articles, published from 1924 to 1949, on the theory, design, and construction of machinery foundations is announced by the Engineering Societies Library. The references also cover specific problems such as heavy machinery foundations on unstable soils, and vibration problems related to foundations of hammers, oil engines, electrical machinery, turbines, steam engines, etc. The bibliography, which is designated No. 5, may be purchased from the Engineering Societies Library, 29 West 39th Street, New York 18, N.Y., at $2.

Pollution Control. To assist state and interstate water pollution control agencies in carrying out their programs, the Division of Water Pollution Control of the U.S. Public Health Service has compiled a mimeographed list of references in the field. Copies of the listing, entitled *Guide to Source Material on Water Pollution Control*, may be obtained from the Public Health Service, Division of Water Pollution Control, Washington 25, D.C.

Electronic Calculation. For the convenience of the construction industry, the International Business Machines Corp. has published a 20-page illustrated booklet entitled *Fundamentals of Electronic Calculation*. As an example of the successful replacement of costly experimentation by economical calculation, the publication cites a calculation, providing a complete numerical analysis of the behavior of a pile when struck by a pile-driving hammer, performed by the IBM Technical Computing Bureau for the Raymond Concrete Pile Co. Free copies of the publication may be obtained from the International Business Machines Corp., 590 Madison Avenue, New York 22, N.Y.

Highway Improvement. The essentials of an effective and economical road-development program are set forth by Carl E. Fritts, director of the Highways Division of the Automotive Safety Foundation, in a recent ASF booklet entitled *Better Roads—Today's Challenge*. Measuring the highway problem in terms of physical deficiencies, congestion, accidents, lack of parking facilities, deficiencies in management, and shortage of competent engineering supervision, Mr. Fritts presents it as a challenge, to legislators, administrators, and engineers. Address requests for copies to the Automotive Safety Foundation, 700 Hill Building, Washington 6, D.C.

Atomic Blast Damage. Previously unpublished details on atomic explosions, with estimates of the probable effect on American cities, are being made public by the Atomic Energy Commission in an official government document entitled *The Effects of Atomic Weapons*. Of primary value to persons engaged in civilian defense and the building trades, the illustrated publication describes the types of buildings that can best withstand the shock and hazards of various kinds of radiation. Orders at $1.25 a copy may be placed with the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

(*Continued on page 83*)

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Bettendorf Super Market
Dickie Const. Co., Wischmeyer and Lorenz, Arch.

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- **FASTER CONSTRUCTION** — Light . . easily handled . . prefabricated to speed the job.
- **ADAPTABLE** — They combine efficient structural function with architectural versatility.
- **ECONOMICAL** — They assure more room at less cost. Their high strength plus light weight provide substantial savings in foundation and framework, and utility conduits, pipes and lines are easily threaded through the open webs.

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LACLEDE STEEL COMPANY
St. Louis Mo

(Continued from page 82)

Hydraulic Turbines. A 56-page bulletin describing the design and construction of Francis, propeller and impulse type, hydraulic turbines, and such auxiliaries as pressure regulators, special high-head valves, butterfly valves, and cabinet-type governors for large units has been released by Allis-Chalmers. Copies of the bulletin, designated 02B7301, are available upon request from the Allis-Chalmers Manufacturing Co., 1187 S. 70th Street, Milwaukee, Wis.

Highway and Bridge Loading. Results of a cooperative investigation of bridge types, undertaken jointly by the Bureau of Public Roads and the Texas Engineering Experiment Station of the Texas A & M College System, are reported in the Station's recent Bulletin No. 116. Authors of the bulletin, which analyzes highway loads and their effects on highway structures and compares heavy motor vehicle operation in the eastern and western parts of the country, are Henson K. Stephenson and A. A. Jakkula, Members ASCE. Requests for copies of Bulletin No. 116 should be addressed to the Texas Engineering Experiment Station, Texas A & M College System, College Station, Tex.

Housing. Government housing activities for the calendar year 1949 are summarized in the Third Annual Report of the Housing and Home Finance Agency. The 400-page report also includes data on the activities of the HHFA and the Office of the Administrator as well as information on housing activities in general. Copies are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at $1 each.

Building Code. A "performance type" building code, prepared by the Building Officials Conference of America, Inc., has been published in abridged form for the benefit of communities largely residental in character. The Abridged Building Code may be obtained from the Building Officials Foundation, 51 East 42nd Street, New York 17, N.Y., at $3 a copy, paper covered, and $4.50 in cloth covering. Copies of the Basic Building Code will be available in August at $5 in paper covers and $6.50 in cloth.

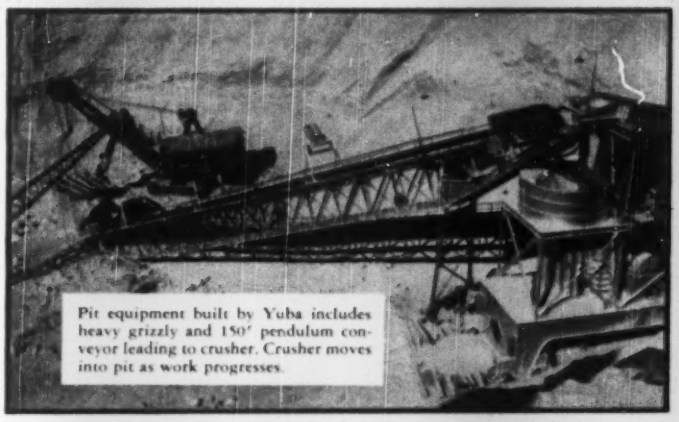
Paving Handbook. All phases of paving with Bitumuls Emulsified Asphalt and with other types of bituminous binders are covered in a new 80-page edition of the Bitumuls Paving Handbook, which is in practical pocket-size format. In addition to information and specifications on methods and materials utilized in various types of construction, the booklet gives complete tabular data on rates of application of asphaltic binders and quantities of aggregate required and condensed Asphalt Institute specifications on asphalt, cement, and cutbacks. Published jointly by the Stancal Asphalt & Bitumuls Co. and the American Bitumuls Co., the booklet is free to technical men. Requests should be made, on your business letterhead, to either company at 200 Bush Street, San Francisco 4, Calif.

(Continued on page 85)

DREDGE EXPERIENCE *PAYS OFF*

YUBA BUILDS PLANT TO PROCESS 17,000 TONS ORE DAILY

Steep bedrock, porous ground, and pit depth of 375′ made the use of bucket ladder dredges impractical on Round Montain Gold Dredging Corporation's vast ore bodies in Nye County, Nevada. To profitably work the property, a new approach was required.



Pit equipment built by Yuba includes heavy grizzly and 150′ pendulum conveyor leading to crusher. Crusher moves into pit as work progresses.

COMBINATION METHOD SOLVES PROBLEM

Yuba engineers, in cooperation with Mr. W. C. Browning, Vice-president and consulting engineer of the Corporation, designed a plant that is basically a combination of gravel and open pit mining methods coupled with a dredge-type treating plant. A shovel and rail mounted crusher with pendulum conveyor handle the ore in the open pit. Belt conveyors carry the ore from pit to stockpile. At the stockpile, YUBA erected a complete dredge-type treatment plant, with revolving screens, jigs, gold tables, sand pumps, sand wheels, and tailing stacker. This YUBA-built plant is capable of moving 17,000 tons of ore from pit, through mill, to tailings every 24 hours.

YUBA WILL BUILD TO YOUR ORDER

You, too, can profit from YUBA's more than 40 years of experience in designing and manufacturing dredges and allied equipment for digging and treating alluvial materials. Bring your problems to specialists — YUBA MANUFACTURING CO. No obligation; just write or wire TODAY.

Plant combines dredges and hard bedrock processing methods.

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YUBA MANUFACTURING CO.

Room 6716 351 California St., San Francisco 4, California, U. S. A.

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CONSTRUCTION MANAGER-CHIEF ENGINEER. M. ASCE; civil engineering graduate; 27 years' experience on varied heavy engineering assignments in United States and abroad; for the past 12 years in charge of design or construction. Excellent health, under 50 with considerable foreign work since War. Available September 1 for foreign assignment. C-616.

SANITARY ENGINEER. Assoc. M. ASCE; 34; married; graduate; 7 years' experience on layout, design, and operation of water and sewage systems and treatment plants; 3 years' experience on designs of reinforced concrete and timber structures and general engineering work. Reasonable salary considered only. Available in 60 to 90 days. Prefers foreign location, but will consider domestic also. C-617-500-A-2.

Positions Available

ASSOCIATE PROFESSOR in civil engineering; master's degree required; professional degree or doctor's degree desirable. Will teach a broad range of undergraduate courses to include thesis direction, contracts and specifications, highways, hydraulics, theoretical courses in structures; assist in the teaching of elementary engineering subjects. Should have had 2 or more years' practical experience or the equivalent in consulting practice, 8 or more years' college teaching on a full-time basis or equivalent professional experience. Salary, $4,800–$6,800 for 12 months. Starts September 1, 1950. Location, Midwest. Y-3761.

CONSTRUCTION SUPERINTENDENT, 40–50, with at least 10 years' experience covering fireproof steel-frame buildings, reinforced concrete structures, apartments and small homes, to take charge of $6,000,000 project. Salary, $10,400–$11,500 a year. Location, Central New York State. Y-3798.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

BRIDGE ENGINEER, under 55, graduate, with 15 to 18 years' experience in the design, construction, inspection, and rehabilitation of railway bridge structures of steel, reinforced concrete and wood, both substructure and superstructure. Some traveling. Salary, $6,096 plus traveling expenses. Headquarters, Florida. Y-3760.

MAINTENANCE AND EQUIPMENT MANAGERS (2), 21–30, who has had some civil administration experience in civil, mechanical or electrical engineering; utility maintenance or construction work essential; knowledge of steam generation plants, water treatment and sewage disposal systems necessary. Some knowledge of Army maintenance desirable. Two-year contract; salary, $4,750–$5,200 a year. Transportation furnished, family accommodations available. Must pass rigid physical examination. Location, Europe. Y-3782.

CLERK OF THE WORKS, preferably single, with experience in building, or training at engineering school, preferably both. Must be an American citizen, with some knowledge of French or Italian. Will familiarize himself with the plans and specifications of the work and observe that the contractor carries out faithfully the requirements of the contract. Prepare daily reports on the progress of the work. Salary, $3,000 a year plus transportation. Location, Europe. Y-3801.

SUPERINTENDENT AND ENGINEER with at least 5 years' surveying, drafting, planning, and construction experience, to supervise layouts, road construction, etc., on realty development project. Salary, $5,200–$6,500 a year. Location, suburban New Jersey. Y-3810.

RESEARCH ENGINEER with some experience in concrete and structural research, for university research foundation. Salary, $3,000–$3,600 a year. Location, Ohio. Y-3817.

STRUCTURAL RESEARCH ENGINEER, to supervise the execution of an architect-engineer contract, involving research into the loading of and structural response of industrial structures to high-frequency, high-amplitude impulsive loadings. Duration of work 2 to 3 years, with probability of permanent work. Will be stationed overseas in a tropical climate for a period of about 8 or 9 months, after which he will come back to supervise the continuing phases of this work. Headquarters, Ohio. Salary, $7,600–$8,600 a year. Y-3821.

SALES MANAGER, under 45, civil graduate, with at least 10 years' experience in selling and supervising a sales organization in concrete products field; to take charge of sales staff for manufacturer of fireproof products. Salary, $6,000 a year plus bonus. Location, Metropolitan area. Y-3831.

RESIDENT ENGINEER, 28–40, civil, electrical, or mechanical degree, with at least 2 years' experience supervising construction in the field; also at least 1 year of design experience. Salary, $5,000–$6,500 a year. Location, Upstate New York. Y-3847.

STRUCTURAL ENGINEER AND DRAFTSMAN, for work in design drafting, specifications and job supervision. Send sample of structural drafting, education and experience record. Salary, $5,500 a year. Location, Louisiana. Y-3858.

SUPERINTENDENT, CONSTRUCTION; B.S. desirable. 35–50; 10 years' experience on heavy construction work, preferably water works. Concrete form work, brick work, and estimating. Supervise construction of water-works projects for a contractor. Salary, $125 a week. Location, Wisconsin. R-6554.

ASSISTANT PROFESSOR OR INSTRUCTOR, civil graduate, preferably with graduate work and practical experience, to teach sanitary engineering. Salary, $3,000 a year minimum. Location, New York, N.Y. Y-3876.

CODE WRITER, civil graduate, experienced in building construction and experience with various building codes, to write, revise and develop a new state building code. Salary open. Location, Mid-west. Y-3920D.

ESTIMATOR or COST ENGINEER

wanted for work in Brazil. Age 28 to 40. By North American Company which has been building hydro-electric projects in Brazil for past 50 years. First class engineering and construction organization with good opportunities for future. Salary to suit qualifications. In reply state experience and personal status in detail. Reply to Dept. WHK Canadian Brazilian Services, Ltd., Yonge & Gerrard Sts., Toronto, Ontario, Canada.

STRUCTURAL DESIGNER WANTED

Structural designer C.E. graduate major in structural design with 3 to 5 years experience in design of steel and reinforced concrete structures, experience in structural design in oil refineries or chemical industry desired.

Box C.E. 189

CIVIL ENGINEERING

33 West 39th Street
New York 18, N. Y.

(*Continued from page 83*)

Modular Coordination. Articles on modular coordination in construction and on water-vapor resistance of building materials comprise Technical Bulletin No. 11, published by the Housing and Home Finance Agency, Office of the Administrator, Washington 25, D.C.

Dry Ice Creates Cofferdams for Bridge Pier Repair

(*Continued from page 26*)

Following the use of dry ice at the Elm Park Bridge, this method was tried out by a local contractor who had run into trouble with the excavation for a small bridge pier. He had to construct a concrete footing 6×28 ft in the bed of a small stream in which there was about 6 in. of water under $2^1/_2$ ft of ice. As there was only 3 to 4 ft of excavation to be made in the bed of the stream, and as the weather was very cold, the contractor hoped to perform the excavation by alternate freezing and trenching.

He was unable to get the excavation to the full depth because of water breaking through the ice cofferdam, and it looked as if he would have to resort to driving sheathing. However, he decided to try dry ice, and with an expenditure of $160 for it he succeeded in making a dry excavation. He pumped the hole as dry as possible, placed the blocks of dry ice, and covered them well with weighted canvasses. The hole was permitted to fill with water. After the dry ice had had time to take effect, the water was pumped out. The bottom was found to be frozen sufficiently to stop the inflow of further water. Another application of dry ice enabled the excavation to be completed and the concrete footing constructed in the dry.

It is not suggested that dry ice is suitable for constructing large cofferdams or that it can take the place of the refrigeration process, but there is no doubt that on small jobs under favorable conditions it can be used effectively and economically to construct ice cofferdams to a depth of 7 ft or more. The fact that this method requires no equipment other than hand tools makes it very convenient and easy to use.

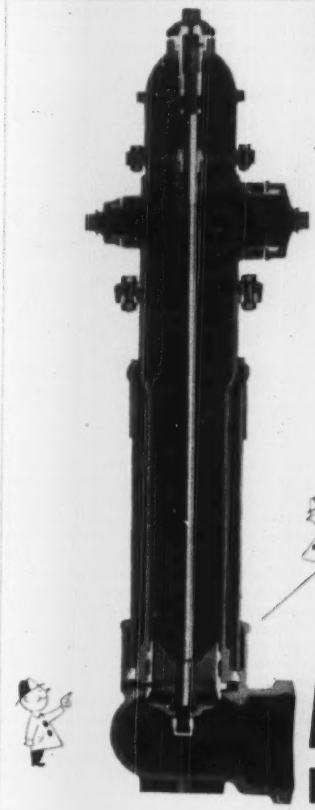
(*This article is based on the paper presented by Mr. Taunton before the joint session of the Construction-Power Divisions at the EIC-ASCE Meeting in Toronto.*)

Over-All National Water Policy a Necessity

(*Continued from page 23*)

Until recently, many sincere people in the Missouri Basin held the belief that construction of the reservoirs in the upper part of the Basin would almost completely eliminate floods in the lower river. Federal agency officials, as recently as May 1950, told the people of Missouri that floods on the Missouri River in Missouri would continue to occur even when all the reservoirs planned outside of Missouri have been constructed and placed in operation. In recognition of this situation, setback levees are proposed extending from the mouth of the river upstream to Sioux City, Iowa, and not less than 13 large reservoirs are proposed on the river's tributaries in Missouri. Existing levees, built to confine the river and produce a navigable channel, will be considered a total loss when the set-back levees and accompanying floodways have been completed. Residents in the flood plain have been advised that land drainage behind the authorized set-back levees will not be a concern of federal agencies but will be a problem to be solved by local levee districts. Much concern is now being expressed in Missouri over this problem, which heretofore did not exist.

(*This article is based on Mr. Horner's address before the Joint Membership Luncheon at the EIC-ASCE Meeting in Toronto, Canada.*)



COMPRESSION-TYPE VALVE PREVENTS LEAKAGE AND FLOODING

Traffic accidents are a problem to consider in buying fire hydrants today. What happens when a hydrant is the loser in an argument with a 10-ton truck? Your community can rely on the Mathews Modernized Hydrant to make the best of a bad job. Rest assured there will be no flood damage to cause law suits. Its compression-type valve prevents leakage—and replacement takes only a few minutes. Depend on Mathews, the leader for more than three-quarters of a century.

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Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

THE FIREMAN'S FRIEND

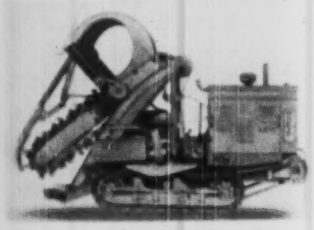
Mathews Modernized Hydrants Set the Pace: Easily maintained, because simple in construction • All working parts contained in replaceable barrel • Stuffing box cast integral with nozzle section • Head can be turned 360° • Replaceable head • Nozzle sections easily changed • Nozzle levels raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for extra strength, toughness, elasticity • Operating thread only part to be lubricated • A modern barrel makes an old Mathews good as new

EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Service Utility Ditcher

THE BUCKEYE MODEL 402 service utility ditching machine has a maximum depth of 4 ft maximum cutting width of 8 in. It was designed to be used for house service connections, telephone lines, gas, water or electrical lines, railway signal cable, foundation footings and other miscellaneous ditching jobs that fall within its width and depth of cut. Powered by a 47 hp at 1600 rpm gasoline engine, it has a top digging speed of 1308 ft per hr. A heavy-duty 10-in. over-center type clutch enables the operator to disengage the clutch, leave the machine in gear and remove his hand from the clutch lever and still keep the motor running. This machine is completely mounted on Buckeye non-clogging self-cleaning crawlers. The crawlers are provided with a spring release to prevent damage. A unique feature of this ditcher is that it can work on hillsides or with one crawler in the gutter and the other in the parkway. This is accomplished by the left-hand crawler which is adjustable vertically 8 in. The rugged heavy duty boom is of two-piece box type construction. A simple means is provided on the boom to adjust the rugged digging chain. Wear plates are located at the top and bottom of the boom to lengthen the life of the boom and chain. A unique telescoping shoe post was designed which automatically retracts when stabbing holes and employs a means for a quick reset to the digging position. A spring

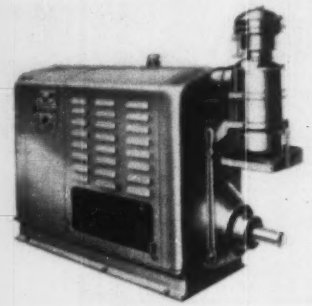


Model 402

loaded safety device protects the assembly if it becomes caught on an obstruction. Two dirt plows are provided to keep the immediate ditch bank free of spoil so that workmen can work near the bank without danger of kicking spoil back into the ditch. All transmissions are fully enclosed and dirt sealed. The boom is lowered and raised by means of a self-locking worm hoist. This self-locking hoist lends itself to positive boom control at all times. The hoist is powered directly from engine transmission by means of a high speed roller chain and sprocket. Further information may be obtained by writing **Gar Wood Industries, Inc., Dept. 022-10, Findlay Div., Findlay, Ohio.**

Diesel Engine

A COMPACT, LIGHT WEIGHT diesel engine, now being manufactured, promises the economy and efficiency of diesel power in scores of applications where such power could not be used before because of size and weight. The engine, designated the "110" because of its 110 cu in. displacement per cylinder, is a 6-cylinder 2-cycle unit rated at 275 hp. The "110" is built to meet the higher power requirements of large earth-moving vehicles, general industrial, oil field and marine equipment.



Model 110

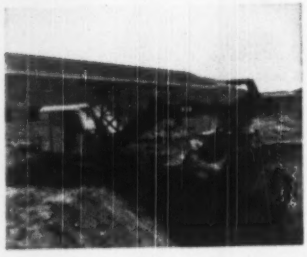
Features include blower scavenging with a new and highly efficient gear-driven centrifugal blower furnishing considerably more air for the cylinders than is needed for combustion. Location of the blower at the rear of the engine, above the flywheel, not only offers the best possible connection to the main gear train, but also contributes to compactness. The blower impeller is an aluminum alloy forging 9 in. in dia and is of the open type with radial vanes. A spiral air inlet helps maintain its high efficiency. GM unit injectors (one for each cylinder) pump, meter and atomize the fuel, and are easily removed for inspection or exchange. The engine is of rugged heavy-duty construction throughout. All wearing parts such as cylinder liners, bearings, valve guides and inserts are precision parts and are readily replaceable, which adds to engine life and to ease of repair. The customary forced feed lubrication is provided, with a gear-driven pump delivering 45 gpm at 1,800 rpm. The "110" is offered as a bare engine, with full equipment for marine or industrial use or with special accessory arrangements for a variety of end products. Optional accessories, which may be powered directly from the gear train, include a hydraulic steering pump, an air compressor and a pump to circulate oil through a GM Torque Converter. **Detroit Diesel Engine Div., General Motors Corp., 13400 W. Outer Drive, Detroit 28, Mich.**

Microfilm Reader

A 35-MM. DESK-TOP microfilm reader, for use in libraries, colleges, newspapers, and industrial drafting rooms, is announced. Designated the Model MPE, the reader will project both 16 and 35 mm. negative or positive film, perforated or unperforated. Magnification in the MPE reader is 19 to 1, especially suitable for reading microfilm editions of newspapers photographed at reduction ratios of either 16 to 1 or 20 to 1. A scanning device allows the film to be moved laterally so that images, the full width of film, can be projected. Any part of the document can be moved to the center of the screen for easier reading. The reader is slightly over 3 ft high, and occupies less than 2 ft sq on the desk top. Weighing less than 50 lb it can be moved about the office easily. The Model MPE will be marketed as the Kodagraph Film Reader by Kodak dealers and as the Recordak Film Reader by Recordak Corporation. **Eastman Kodak Co., Rochester 4, N.Y.**

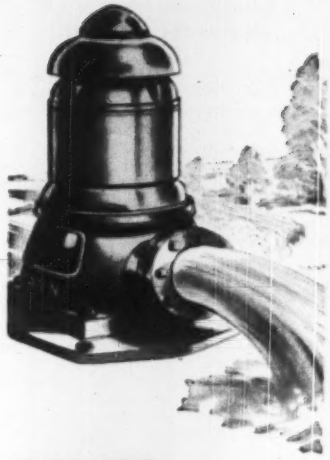
Trench Hoe

A "GOOSENECK BOOM" hoe attachment for the P&H Model 255A excavator is announced. This attachment incorporates many new features in trench hoe design which make possible higher speeds, greater digging depth, maximum ruggedness and better over-all performance. Operation of



Model 255A

the P&H trench hoe is 50% faster due to only a two-part hoist line. It has a power operated auxiliary gantry for raising and lowering the boom. The new design permits greater digging reach and digging depth and greater dumping height. This means fewer moves and more yardage. Also, a greater amount of power is made available for the toughest digging by low-gear transmission. The machine can cut vertical end at start of the trench and also can trim vertical walls. There is a chopping action due to the special hoe stick linkage. Information may be obtained by writing **Harnischfeger Corp., Small Excavator Div., Milwaukee 14, Wis.**



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Equipment, Materials & Methods (Continued)

Cement Batcher

A BULK CEMENT BATCHER that is easily portable has been manufactured. The Ferguson cement batcher has capacity for a dual-drum paver—up to 12 cu ft per batch—and will handle bulk cement either at the freight car or on the job. Batching cement in bulk creates large savings in labor, time and cost of cement sacks. Accurate scales and controls on the Ferguson batcher are located for handy operation by one man. Entire apparatus is watertight and bin can be locked. Power is provided by 16 hp, 4-cylinder engine, complete with totally enclosed gear reduction, clutch and 4-speed transmission.

Ferguson Batcher

The batcher can be set up ready for work in 5 min by rotating elevator around center pin into working position, then retracting wheels mechanically and setting up ramps for loading truck. It can be ready to move in 2 min. Unloading ramp forms gooseneck for attaching to fifth wheel of truck, or batcher can be towed behind ordinary dump truck. Overall height in trailing position is 12 ft 6 in. Complete information and prices may be obtained by writing **Shovel Supply Co., Box 1369, Dallas, Tex.**

Segmented Guide Roll

TANDEMS IN THE EIGHT to fifteen ton class may now be equipped with a new type of segmented guide roll, said to give better compaction results than obtainable with a sheepsfoot type roller. The roll consists of two sections mounted on roller bearings and free to rotate independently on the guide roll axle. Heavy steel pads, mounted on sturdy spokes, are placed in staggered rows around the axle, forming the actual compacting surfaces of the roll. The pad, or segmented type roll is designed and constructed so that the pads enter the loose material with a minimum of displacement, thus eliminating undesirable forward flow of the materials. Compaction takes place only at the lower elevations of the loose material, and the pads leave the material layer without disturbing the compacted material. Thus the roll uniformly compacts the material layer

(*Continued on page 88*)

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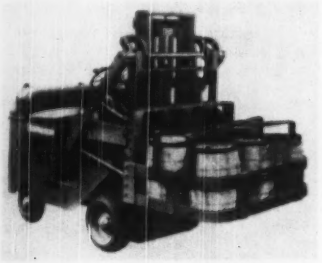
602 HAMMOND BLDG., DETROIT 76, MICH.

Equipment, Materials & Methods (Continued)

throughout the entire depth, and subsequent treatment and rolling of uncompacted top layers of material is not necessary. Detailed specifications and information concerning both the old and new models on which the roll can be installed may be obtained by writing the **Buffalo-Springfield Roller Co., Springfield, Ohio.**

Keg Handling Device

THE LATEST HYDRAULIC keg handling device picks up, transports, stacks and unloads—without a pallet—six 200-lb kegs of spikes in a single maneuver. To pick up a load, a guide frame mounted on a Towmotor Unloader accessory with 10-in. stroke is lowered over the kegs; as the Unloader is retracted the guide frame pulls



Model LT-44

the kegs against three rubber-covered shoes which project from the face of the carriage. The six kegs, held securely in position by the guide frame, are firmly pressed against the projecting shoes and can be picked up and transported rapidly and safely. Note that the need for a flat carrying plate has been eliminated. Both shoes and guide frame are easily detachable, so that this Model LT-44 Towmotor lift truck can be used with standard forks. **Towmotor Corp., Cleveland, Ohio.**

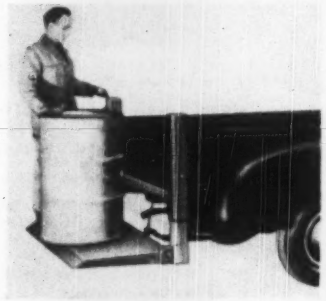
Uni-Flo Model EF Grille

DESIGNED FOR VENTILATING or air-conditioning systems, the Uni-Flo fixed fin Model EF supply grille is efficient and attractive. Accurately formed diffusion fins impart a turbulent action to the supply air which minimizes drafts and produces rapid temperature equilization. These grilles have a large free area for low noise level and minimum pressure drop. For ease in installation, the frames are drilled for mounting screws. Ruggedly constructed Uni-Flo grilles withstand severe abuse. These grilles are available in a wide range of sizes for any installation and in a gray prime coat or electroplated metal finishes to harmonize with any decoration. **Barber-Colman Co., Rockford, Ill.**

Equipment, Materials & Methods (Continued)

Hydraulic Tailgate Loader

A HYDRAULICALLY POWERED tailgate loader for pickup trucks, called the Lift-O-Matic, has been developed. The loader can easily be installed on most pickup trucks. Its lifting capacity is 1,000 lb. The hydraulic power is provided by a fan-belt driven hydraulic pump with its own self-contained clutch. The pump operates only when lifting power is needed. One handy control, installed on the Lift-O-Matic, is used for either raising, holding or lowering the tailgate. The operator can



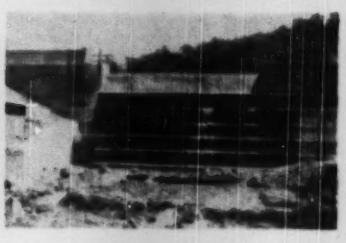
The Lift-O-Matic

operate the unit while riding up or down with the load. It is all steel and sturdily constructed. When it is not being used to load or unload the truck, it can be level-locked at the truck body floor level, or it can be swung up and securely locked, acting as a regular tailgate. A safety bypass valve in the hydraulic pump prevents overloading and endangering the hydraulic system. The loader speeds up loading and unloading pickup trucks, enables one man to handle all the loading and delivering, helps prevent damage to heavy merchandise that presents difficult loading and unloading problems even with two or more men on the job. **National Lift Co., Dept. 2029, 225 Madison St., Waukesha, Wis.**

Ply Hole Cover

NO MORE DO CONTRACTORS who use plywood for forms need to spend time hunting for the right size cork to cover a hole to enable them to re-use their forms. The change has been accomplished by the invention of a simple metal disk, constructed with barbs, called a ply hole cover. These covers are placed over the unneeded hole and, with one blow of a hammer on the magnetic setting tool, they are driven flush with the surface of the plywood. The covers came in 3 sizes: $1^3/_4$, $2^1/_4$ and $2^3/_4$ in. in diameter. Both time and money is saved with this neat, mechanical way of covering a hole, so mass production has started at the **Troiel Co., Inc., 839 Channing Way, Berkeley 2, Calif.**

"GUNITE work by Cement Gun Co. makes Dam Better than New



The picture, above left, shows the advanced state of disintegration that existed when we were called in to repair a 50 year-old Gravity Dam. After we placed a solid "Gunite" blanket on the entire upstream side, seepage through the dam stopped completely. "Gunite" treatment on the down-stream side (above right) make the dam stronger than when it was originally constructed. Throughout the operation, water was controlled so that the town's supply was not interferred with in any way.

Many instances of repair, remodeling and new construction with "Gunite" are described and pictured in Bulletin B2400. A request on your letterhead will bring your free copy by return mail.

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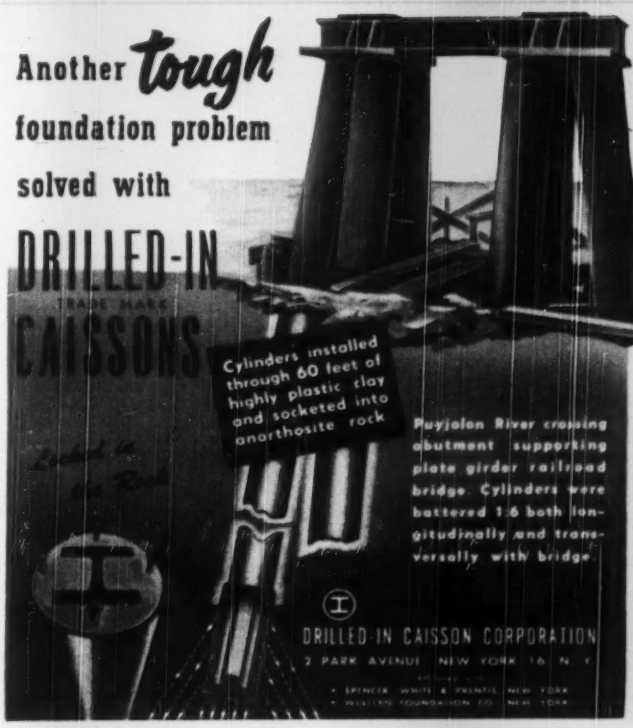
Cylinders installed through 60 feet of highly plastic clay and socketed into anorthosite rock
Puyjolon River crossing abutment supporting plate girder railroad bridge. Cylinders were battered 1:6 both longitudinally and transversally with bridge.
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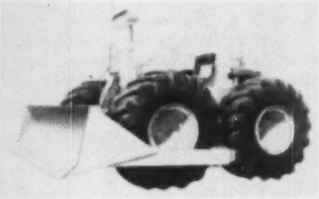
Equipment, Materials & Methods (Continued)

Tournadozer

TO MEET THE NEED for a speedy, rubber-tired, four-wheeled tractor dozer to handle jobs which do not demand the use of the larger, standard size Tournadozer, a manufacturer of earthmoving and construction equipment has introduced the smaller size Model Super D Tournadozer. Some 3500 lb lighter and equipped with a smaller capacity bowl than the Super C Tournadozer, the Super D is powered by a 122-hp diesel engine. Capacity of the Super D's bowl is 1.8 yd . . . the Super C's capacity is 2.5 yd. The smaller model retains the advantage of high speed, having four speeds forward up to 19 mph, with two reverse speeds. It is mounted on big rubber tires which are available in two



The Super D

sizes—21 × 25 or 56-in. wide base rim. These tires permit operation in soft going at reduced air pressures. The Super D is equipped with a Tournamatic transmission and air-synchronized, multiple-disc clutches. Super D also meets the need where a fast, rubber-tired mobile tractor is required for towing purposes, such as in farming, logging, pits and quarries, oil fields and many other industrial applications. Attachments available are a snow plow, root rake, side boom crane, Tournaskidder (overhead winch to facilitate dragging of logs, beams, forms, etc.), single and double drum power control unit, and drawbar for cable-operated scrapers. **R. G. LeTourneau, Inc., Peoria, Ill.**

Water Repellent Treatment

NOW, WITH JUST THE MINIMUM of special equipment, an elastic coating called Tremco 101 Mastic can be sprayed on masonry. This mastic water repellent is used effectively on all unglazed masonry surfaces including cement block, concrete block, brick, stucco, cast-stone, stone and other surfaces. Thus, spalling, cracking, crazing and general disintegration of masonry is effectively prevented. Its availability in such attractive colors as natural cement, off-white, light yellow, terra cotta, slate and dark red, makes it a very versatile treatment that can be effectively used on industrial, commercial or residential buildings. One very outstanding characteristic of Tremco 101 Mastic is this combination of a utilitarian treatment

(*Continued on page 91*)

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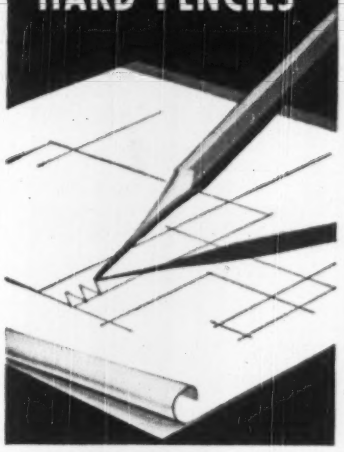

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Equipment, Materials & Methods (Continued)

that is at the same time attractive. Stucco buildings can still retain their stucco appearance, and concrete buildings can be made to look like new again. Although the spray application of 101 is the most efficient and economical way to coat large areas, often costing less than plaster coats, it can also be applied by brush or by trowel. But regardless of the method that is used, the final job is a coating about ten times the thickness of paint. It resembles a plaster coat in appearance. But because it is a mastic, Tremco 101 remains pliable and resilient and, therefore, easily absorbs the normal amount of expansion and contraction of buildings. **Tremco Mfg. Co., 8701 Kinsman Rd., Cleveland, Ohio.**

Under-Car Unloader

A NEW COMBINATION BELT and positive chain drive hopper bottom car unloader for handling aggregates: sand, gravel, crushed stone and any material loaded in hopperbottom cars has just been introduced. Capacity of the machine is up to 3 tons per min. Complete information can be obtained by writing for Bulletin 501. **George Haiss Mfg. Co., Inc., 381 Canal Place, Bronx, New York 51, N.Y.**

Haiss Unloader

Diesel Truck Engines

THE DEVELOPMENT OF three new 161 Series, heavy-duty diesel truck engines—models 6 DAS-844 Supercharged, 280 hp diesel; 6 DA-844, 215 hp diesel; and 6 DA-779, 185 hp diesel—have been announced. All are six-cylinder diesels with practically the same mounting dimensions and are built on the same 161 Series production line. The displacement of these Dyna-diesel engines is 844 and 779 cu in., respectively. All three engines have the same bore of $5^1/_4$ in. The stroke of the 844 engines is $6^1/_2$ in.; the stroke of the 779 engine is 6 in. The features of these truck diesels are more power with less weight, lower fuel consumption, more mileage between overhauls, less maintenance on the road, no smoke and smoother operation.

(*Continued on page 92*)

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TIDE GATES

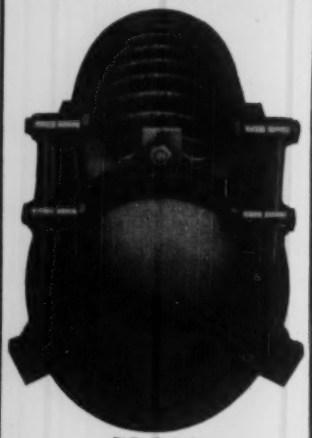

FIG. B-147

Type M-5 Tide Gates for use with Corrugated Culvert Pipe. Bulletin No. 91 describes them fully.

BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

Equipment, Materials & Methods (Continued)

These DA engines have a special monolobe Dyna-Swirl combustion chamber which enables these engines to develop increased horsepower. Crankshafts are completely counterbalanced and engines are provided with torsional vibration dampeners to insure smoother engine operation. A large number of the engine parts such as intake manifolds, compressor brackets, oil cooler housing, gear housing and covers, etc., are made of aluminum to reduce the total weight of the engine. **The Buda Co., Harvey, Ill.**

Road-Marking Machine

THOSE MILES AND MILES of white lines used on open roads to mark the center of the road, and the more numerous, but less lengthy, lines indicating cross walks, safety zones and parking areas, are becoming an increasingly serious problem. At the least, an enormous amount of paint is used; a very considerable number of man hours—and, up until now, one had the alternative of using either expensive equipment that runs into thousands of dollars—or very small, walking apparatus, that while less expensive to buy, uses up a still greater volume of time and paint. Into this picture has now come a small, riding type tractor, with special equipment and attachments for road marking. It is operated by one man who rides. A tank is attached to the rear of the machine and can be made to carry as much paint as desired. The average is 5 gal. Paint is fed through a spray gun under pressure so that it gives the greatest covering, and therefore enables you to stretch the paint to the limit. The tests showed that 5 gal. of paint will provide markings for up to one mile of roadway. The machine can readily be loaded aboard any small truck with road markers, flags, paints and other apparatus, and be transported to the job with ease. Once the machine is set in motion all action is automatic, and the rider need only steer along the route required. It is geared to travel from 5 to 6 mph—proved as the most efficient speed for spraying on the paint in order to provide the most economical coverage. **Beaver Tractor Co., Inc., Stratford, Conn.**

Socket Screws

THE ADDITION OF SMALLER size socket setscrews and cap screws to Bristol's line of multiple-spline socket screw products has been announced. These are specially designed for use in small assemblies for equipment such as cameras, scientific instruments, electronic equipment, clocks, computing machines, and dental and surgical equipment. The new multiple-spline socket screws are made as small as No. 2 wire size, and the cap screws are made in diameters to No. 0 wire size. Bulletin 879 contains full specifications and prices. **The Bristol Co., Mill Supply Div., Waterbury 20, Conn.**

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Literature Available

DRY LUBRICANT—A 4-page folder describes the properties of Molykote, a dry lubricant primarily valuable in construction because of its anti-seizing properties. It is especially valuable in preventing galling and seizing of metal at bearing pressures as high as 100,000 pound psi. **The Alpha Corp., Greenwich, Conn.**

APPRENTICESHIP—A 28-page booklet, entitled "Apprenticeship Past and Present" describes and illustrates the story of apprentice training in the skilled trades since colonial days. Not only does this booklet reveal the antiquated training methods used by the early settlers, but those in vogue during subsequent periods. The price is 15¢. Copies may be obtained by writing to the **Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.**

AIR PUMPS—How air pumps operate and where they are used effectively are fully described and illustrated in Catalog 450. The catalog contains performance curves and specification tables on 4-wing type and 2-wing type air pumps and accessories. Leiman air pumps are of the rotary positive type, designed for producing vacuums up to 29 in. and pressures up to 25 psi. A section of the catalog deals with air motors which are simply air pumps operating in reverse with compressed air as the power source. **Leiman Bros., Inc., 280-F Christie St., Newark 2, N.J.**

HEAT EXCHANGERS—A catalog has been issued that describes and illustrates the new Series 240A "Karbate" brand impervious graphite shell-and-tube heat exchangers. Catalog Section M-8801.1 contains complete specifications, sectional dimension drawings and ordering information. A copy may be obtained by writing **National Carbon Div., Union Carbide and Carbon Corp., 30 E. 42d St., New York 17, N.Y.**

WIRE ROPE—An informative folder entitled, "Why you should use the best—Streamlined Scraper Rope," has just been released. Contractors, construction companies, engineers; in fact anyone who buys or specifies wire rope for earth-moving machinery, will find this 4-page bulletin exceedingly helpful. It points out the definite advantages of streamlined scraper rope which result in greater man and machine efficiency—more dirt handled—longer rope life and extra safety. For your copy of this folder, send a postcard to **American Cable Div., American Chain & Cable Co., Inc., Wilkes-Barre, Pa.**

EXHIBITING & CONTROLLING INSTRUMENTS—A 28-page illustrated catalog, No. 50, describing new developments, in exhibiting and controlling flow instruments for all industries, has just been published. The basic devices for coupling a primary metering element to a secondary or exhibiting instrument are discussed in this catalog along with the "Magnabond" magnetic clutch and the electric impedance bridge transmitting systems. The exhibiting instruments illustrated and described are: flow indicators, recorders, integrators and a new pneumatic controller unit. **Fischer & Porter Co., 50 County Line Road, Hatboro, Pa.**

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Literature Available (Continued)

HOISTS—An 8-page folder, printed in three colors and well illustrated with photographs, diagrams and line drawings, gives full descriptions, specifications, prices and ordering data on Ohio Bob-Cat heavy-duty electric cable hoists. Copies are available on request to **The Ohio Electric Mfg. Co., 5900 Maurice Ave., Cleveland, Ohio.**

DIESEL ENGINES—Of special interest to users of Diesel power is a recent publication entitled "'Caterpillar' Diesel Engines." The 16-page illustrated booklet contains first hand, complete information on the latest and most powerful Diesel engines, Models D397, D386, D375 and the D364. Copies of this informative pamphlet may be obtained by writing for Form 12725. **Caterpillar Tractor Co., Peoria 8, Ill.**

CONCRETE MIXERS—Bulletin R-217A describes Worthington-Ransome Blue Brute concrete mixers, Models 11-S and 16-S. The two-wheel Ransome 11-S Mixer is especially useful where the contractor is cramped for space at the job site. The four-wheel 11-S Mixer is a well-balanced machine used on curb, gutter and building type jobs. The Ransome 16-S four-wheel Mixers are used on curbs, gutters, and construction jobs such as bridges and culverts. **Worthington Pump & Machinery Corp., Harrison, N.J.**

STRENGTH OF METALS—A colorful illustrated folder describing the strength advantages of Armco metal drainage structures has been published. Entitled "Here's the 'Strong Man' to Handle Your Drainage Problems," the folder points out that three kinds of strength—continuous beam strength, strength to support loads and resist impact, and joint strength—enable metal structures to meet the job needs of highway, railway, airport, municipal, and industrial service. **Armco Drainage & Metal Products, Inc., General Offices, Middletown, Ohio.**

MASTERQUICK METHOD—An iron asphalt patching material which produces long life repairs and makes possible easy, fast patching or resurfacing of worn concrete floors has been announced in an 8-page illustrated bulletin. According to the manufacturer, this material named Masterquick overcomes the problem of early breakdown under impact, particularly of feather edges, encountered with ordinary asphalt patching materials. Copy of bulletin containing complete directions supplied on request. **The Master Builders Co., Cleveland 3, Ohio.**

RUBBER PIPE—An 8-page bulletin explaining the applications and comparative qualities of flexible rubber pipe as against metal pipe in many services, exclusive of long lines, has just been issued. Economies in costs of installation and maintenance as well as longer life are explored in detail. A progressive picture story, occupying 2 pages, shows the greater use of installation claimed for the rubber product. Copies of Bulletin No. H-1 are available by writing to **Hewitt Rubber Div., Hewitt-Robins, Inc., 240 Kensington Ave., Buffalo 5, N.Y.**

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THE FOLLOWING PAPERS, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in three consecutive issues; others will be added every month, as they become available. Use the convenient order form on page 96.

Closed to Further Discussion

1. Improvements at the Back River Sewage Works, Baltimore, Md., by C. E. Keefer, M. ASCE.

2. Public Utility Condemnation Cases in the State of Washington by Henry L. Gray, M. ASCE.

3. Treatment of Foundations of Large Dams by Grouting Methods by A. W. Simonds, M. ASCE, Fred H. Lippold, M. ASCE, and R. E. Keim, Assoc. M. ASCE.

4. Capillary Phenomena in Cohesionless Soils by T. William Lambe, Jun. M. ASCE.

5. Elastic Restraint Equations for Semi-Rigid Connections by J. E. Lothers, M. ASCE.

6. Slope Deflection Equations for Curved Members by Keith T. Fowler, Jun. M. ASCE.

7. The Geochemistry of Earthwork by Hyde Forbes, M. ASCE.

8. Floating Tunnel for Long Water Crossings by Charles E. Andrew, M. ASCE.

9. Atchafalaya River Diversion and Its Effect on the Mississippi River by Leo M. Odom, M. ASCE.

10. Pollution Abatement Policy by Thomas R. Camp, M. ASCE.

Summarized in Earlier Issues

11. Long-Term Storage Capacity of Reservoirs by H. E. Hurst.

12. Influence Charts for Concrete Pavements by Gerald Pickett and Gordon K. Ray, Jun. M. ASCE.

13. Reinforced Concrete Skewed Rigid-Frame and Arch Bridges by Maurice Barron, M. ASCE.

14. Mathematical Analysis of an Aerial Survey by Lo-Ho.

15. Computation of Equitable Charges for Treatment of Municipal Sewage by Ellis E. Bankson, M. ASCE.

D-VII. Discussion of Paper, **Deflection of Plywood Beams Due to Moisture Content Change,** by W. E. Wilson and Laurence G. Olson.

16. Pavement Bearing Capacity Computed by Theory of Layered Systems by Guthlac Wilson, M. ASCE, and G. M. J. Williams, Jun. M. ASCE.

17. Origin and Significance of Openwork Gravel by Allen S. Cary, Assoc. M. ASCE.

18. Successive Approximations for Beams on an Elastic Foundation by E. P. Popov, Assoc. M. ASCE.

19. Flood-Control Operation of Tennessee Valley Authority Reservoirs by Edward J. Rutter, M. ASCE.

20. Three-Dimensional Displacement Diagrams for Space Frame Structures by Walter Worthington Ewell, Jun. M. ASCE.

21. Maximum Load Capacity of Bailey Bridges by Robert B. Stegmaier, Jr., Jun. M. ASCE.

22. Specifications for Heavy Duty Structures of High-Strength Aluminum Alloy, Progress Report of the Committee of the ASCE Structural Division on Design in Lightweight Structural Alloys.

23. Influence of Heavy Loads on Pavement Design Trends by K. B. Woods, M. ASCE.

24. Summary of Buckling of Rigid-Jointed Plane Trusses by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman.

25. Uplift Pressures in Concrete Dams by Kenneth B. Keener, M. ASCE.

D-XVI. Discussion of Paper, **Stream Flow Variability,** by E. W. Lane and Kai Lei. Discussers are: Ven Te Chow, Dana M. Wood, H. Alden Foster, C. S. Ospina and G. Tama, Raphael G. Kazmann, Jack Bruin and H. E. Hudson, Jr., H. W. Lull, William D. Mitchell, C. R. Ownbey, S. P. Wing, J. E. McKee, and G. B. Schroyer and E. T. Schuleen.

Third Notice

D-XVII. Discussion of Paper, **End Restraints on Truss Members,** by Harold E. Wessman and Thomas C. Kavanagh. The original paper, published in September 1949 PROCEEDINGS (p. 951), presented a method of computing end restraints and the effective lengths of compression members under different load conditions. An important conclusion was that when a truss buckles all members tend to fail simultaneously. Critical and constructive comment was received from Jack R. Benjamin, George Winter, Abraham Slavin, J. Edmund Fitzgerald, Joseph S. Newell, and Charles W. Dohn. The authors' closure should be read with interest by everyone concerned with the practice and theory of structures. (Available August 1.)

D-XVIII. Discussion of Paper, **Frequency Analysis of Beam and Girder Floors,** by Hans H. Bleich. The original paper, published in October 1949 PROCEEDINGS (p. 1093), proposed a method for finding the vibration frequencies and modes in three-dimensional structures such as floor systems, multi-story building frames, and airplanes. A brief discussion by Robert V. Hauer, with an answering comment from Mr. Bleich, constitutes the total scope of this Separate. (Available August 1.)

D-XIX. Discussion of Paper, **Roads and Pavements, Sampson Naval Training Station,** by Jacob Feld. The original paper, published in October 1949 PROCEEDINGS (p. 1133), gave a full description of the construction of 65 lane-miles of roads, within a period of six months. Valuable discussion is presented by P. F. Phelan, which calls for a brief closing comment by the author. (Available August 1.)

D-XX. Discussion of Paper, **Aerodynamic Theory of Bridge Oscillations,** by D. B. Steinman. The original paper, published in October 1949 PROCEEDINGS (p. 1147), presented general equations for the determination of vertical, torsional, and coupled oscillations on any structural section of two degrees of freedom. Numerical and graphical examples illustrate the practical application of the underlying theory. Discussers are: David J. Peery, Alexander Klemin, Abraham Slavin, Charles W. Dohn, Boris A. Bakhmeteff, F. J. Maher and J. B. Eades, Edmund Pinney, Harold A. Thomas, Elmo G. Peterson, William Allan, Paul Lieber, S. K. Ghaswala, Peter L. Tea, Edward Adams Richardson, H. H. Bleich.

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F. B. Farquharson, and George S. Vincent. The author's reply is comprehensive and thorough. (Available August 1.).

Second Notice

26. Industrial Stream Pollution Abatement, by L. L. Hedgepeth. In the abatement of industrial pollution of streams, a program based on forthrightness, tact, good will, and good faith will be found profitable. This view is derived from Mr. Hedgepeth's 25 years of experience in stream sanitation, in the employment of industry and of the public. The industrial waste problem is so complex as to defy standardization. In support of his recommendations for regulatory measures, Mr. Hedgepeth cites his work on major pollution sources in Virginia in detail. (Available September 1.)

27. Plasticity of Metals—Mathematical Theory and Structural Applications, by D. C. Drucker, Assoc. M. ASCE. A brief analysis is given of the philosophy and practice of engineering design. The importance of plasticity in most elastic design is emphasized and the use of elementary plastic analysis is illustrated. Applications to beam and truss frameworks (limit design and "shakedown") and structural stability are discussed. A short description is given of the development of mathematical theories of plasticity and the experimental results on which they are based. It is demonstrated that some members may load then unload when all forces applied to a structure increase in ratio. (Available September 1.)

28. Retrogression on the Colorado River Since 1935, by J. W. Stanley. Since its construction, Hoover Dam has eliminated the major flood flows from the lower Colorado River, and has trapped all sediment brought down from the upper river. Controlling floods and impounding the sediment, however, do not solve all problems of the lower river. The river bed still scours in some areas and builds up in others, and bank erosion and changing course cause problems at various locations. To watch changes as they occur and as an aid in planning further physical control, the Bureau of Reclamation has conducted regular surveys along the lower river since 1935. A discussion of these changes is presented in this paper. (Available September 1.)

29. Sedimentation Studies at Conchas Reservoir in New Mexico, by D. C. Bondurant, Assoc. M. ASCE. The importance of sediment deposition in reservoir areas is becoming recognized to an increasing degree, and the problems evolving from sedimentation are now being considered in the planning and design of reservoir projects. Comparative data from existing projects provide the most adequate means for predicting the form and extent of anticipated sediment deposits, since analytical methods for the purpose are yet in the formative stage. The paper presents data on the form and extent of sediment deposits in the Conchas Reservoir together with descriptive data on the contributing drainage. (Available September 1.)

30. Economic Effects of Reservoir Sedimentation, by W. E. Corfitzen, M. ASCE. More storage reservoirs have been created since 1925 than in any period of history, and investigations indicate that sedimentation will limit the useful life of most of them to less than 200 years. Computations of sediment loads and rates and the effects of sedimentation on principal reservoir uses are considered, together with factors involved in computations of the costs of sedimentation. (Available September 1.)

First Notice

31. Measurement and Analysis of Suspended Sediment Loads in Streams, by Martin E. Nelson and Paul C. Benedict. Federal agencies concerned with development of river resources for flood control, irrigation, soil conservation, water power, navigation, and water supply are making a concerted effort to standardize methods and equipment for measurement and analysis of sediment loads in streams. The paper describes such aspects of the fluvial sediment problem as the history of sediment investigations, the theory of the sediment transportation phenomenon, methods and equipment used in sampling sediment, and the development of improved samplers and laboratory equipment for analyzing sediment samples. (Available October 1.)

32. Effect of Skew Angle on Rigid-Frame Reactions, by Walter C. Boyer. The skewed rigid-frame bridge is recognized as a grade-separation structure which conforms ideally to essential road alinement. Methods of analysis are now available which reduce the arduous labor of design once attributed to this structure. In spite of rather general acceptance of present design procedure, doubts are occasionally expressed concerning its validity. This paper describes the test procedure and results obtained from a model study of the rigid-frame bridge and traces the variation of reactive elements for skew angles of from 0° to 50°. (Available October 1.)

33. Strength of I-Beams in Combined Bending and Torsion, by Basil Sourochnikoff. I-beams in combined bending and torsion are often encountered in practice, particularly in structures supporting complex industrial equipment where it is sometimes impossible to avoid eccentric loads on beams. In this paper, stresses in beams due to the interaction of bending and torsion and the influence of the deflections on stresses are analyzed, allowable stress formulas are established, and a comparison with existing design methods is given. (Available October 1.)

34. Lateral Buckling of Eccentrically Loaded I-Section Columns, by H. N. Hill and J. W. Clark. In designing a member for simultaneous axial compression and transverse bending, it is necessary to reduce the allowable end load and the allowable bending moment below the values which would be permitted if either occurred alone. Failure of such a member may result from excessive bending in the plane of the applied bending moment or from lateral buckling. The latter type of failure is the subject of this paper, which reports the results of tests on I-section columns loaded eccentrically. (Available October 1.)

35. Design Curves for Footings on Soil, by Winfield A. McCracken. The curves cover footings of uniform thickness and sloped or stepped, footings over a wider range of design conditions than the most comprehensive tables. They can be used with little more effort than a comprehensive table and with the confidence acquired by going through the design procedure rather than with blind acceptance of tabular values. (Available October 1.)

D-XXII. Discussion of Paper, **Analytical Method of Determining the Length of Transition Spiral,** by Michael V. Smirnoff. The original paper, published in November 1949 PROCEEDINGS (p. 1283), presented a step-by-step approach to the problem of expressing the length of transition spiral. Discussion by T. F. Hickerson, Thomas R. Klingel, Carl F. Meyer, Joseph Barnett, J. J. Leeming, Allen G. Tyson, Donald Thompson, and Ralph A. Moyer, and the author's closing arguments, will be read with keen interest by specialists in the field. (Available October 1.)

D-XXIV. Discussion of Paper, **Diversion Tunnel and Power Conduit of Nantahala Hydroelectric Development,** by D. J. Bleifuss. The original paper, published in December 1949 PROCEEDINGS (p. 1409), gave, in detail, the salient design considerations of a part of a great hydroelectric project in North Carolina. A thorough discussion by Joseph R. Bowman emphasizes the particular problems of energy dissipators, gate guide alinement, gate-opening devices, the power intake gate hoist, the pipe line, penstock, and surge tank. Each of these topics is taken up in turn in the author's brief closing discussion. (Available October 1.)

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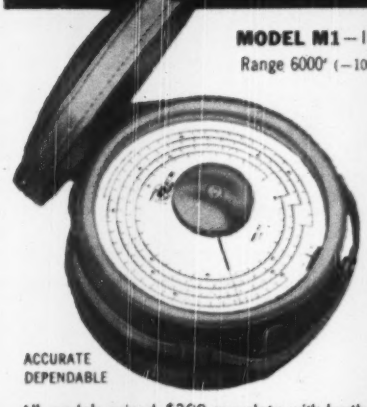

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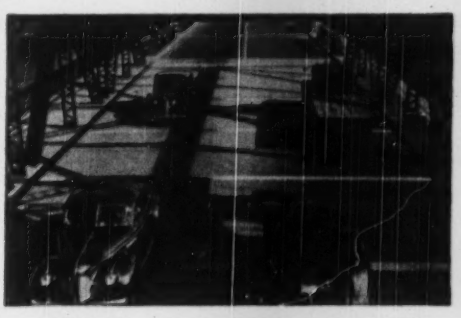

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INDEX TO ADVERTISERS

ALLIS-CHALMERS MANUFACTURING COMPANY	81
AMERICAN BITUMULS COMPANY	61
AMERICAN PAULIN SYSTEM	99
ARMCO DRAINAGE & METAL PRODUCTS, INC.	2
AUSTIN-WESTERN COMPANY	69
C. L. BERGER & SONS, INC.	87
BROWN & BROWN, INCORPORATED	92
CARNEGIE-ILLINOIS STEEL CORPORATION	4 and 5
CAST IRON PIPE RESEARCH ASSOCIATION	12 and 13
CATERPILLAR TRACTOR CO.	11
CEMENT GUN COMPANY	88 and 89
CHICAGO BRIDGE & IRON COMPANY	67
THE DORR COMPANY	73
DRILLED-IN CAISSON CORPORATION	89
ECONOMY FORMS CORP.	92
ELLICOTT MACHINE CORPORATION	94
GENERAL ELECTRIC COMPANY	3
W. & L. E. GURLEY	7
IMPERIAL PENCIL TRACING CLOTH	91
INTERNATIONAL HARVESTER COMPANY	8 and 9
IRVING SUBWAY GRATING CO., INC.	91
KERLOW STEEL FLOORING CO.	99
KEUFFEL & ESSER CO.	91
WM. F. KLEMP COMPANY	1
KOPPERS COMPANY, INC.	93
LACLEDE STEEL COMPANY	82
LAYNE & BOWLER, INCORPORATED	87
LOCK JOINT PIPE COMPANY	4th Cover
LONE STAR CEMENT CORPORATION	14
MACARTHUR CONCRETE PILE CORP.	91
THE MASTER BUILDERS CO.	3rd Cover
MERRITT-CHAPMAN & SCOTT CORPORATION	79
MORETRENCH CORPORATION	92
NATIONAL CLAY PIPE MANUFACTURERS, INC.	10
PENNSYLVANIA DRILLING CO.	94
PORTLAND CEMENT ASSOCIATION	6
RAYMOND CONCRETE PILE CO.	2nd Cover
RICHMOND SCREW ANCHOR CO., INC.	63
SIMPLEX VALVE & METER COMPANY	78
S. MORGAN SMITH CO.	77
SOLVAY SALES DIVISION, ALLIED CHEMICAL & DYE CORPORATION	100
SPENCER, WHITE & PRENTIS, INC.	88
SPRAGUE & HENWOOD, INC.	92
STANCAL ASPHALT & BITUMULS COMPANY	61
JOHN W. STANG CORPORATION	94
THE TEXAS COMPANY	65
UNDERPINNING & FOUNDATION CO.	94
UNION METAL MANUFACTURING COMPANY	71
U.S. PIPE & FOUNDRY COMPANY	16
U.S. STEEL CORPORATION	4 and 5
VIBER COMPANY	75
DAVID WHITE COMPANY	90
R. D. WOOD COMPANY	85
YUBA MANUFACTURING CO.	83

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